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MINERAL LAND CLASSIFICATION OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES, SAN BERNARDINO COUNTY, CALIFORNIA

1993

CALIFORNIA DEPARTMENT OF CONSERVATION

Division of
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SPECIAL REPORT 168

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MINERAL LAND CLASSIFICATION OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES, SAN BERNARDINO COUNTY, CALIFORNIA

1993

By

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PREFACE

The California Surface Mining and Reclamation Act of 1975 requires the State Geologist to classify land according to the presence, absence, or likely occurrence of significant mineral deposits in certain areas of the state. This Special Report is one of a series of mineral land classification studies being conducted in the Mojave Desert region by the California Department of Conservation, Division of Mines and Geology. The information is provided to the State Mining and Geology Board for transmittal to local governments and Federal agencies who regulate land use in this region.

SUMMARY

This report includes a geologic map of the Kerens, Flynn, and Colton Well 15-minute quadrangles (Plate 1) and Mineral Land Classification maps which display areas that contain or are likely to contain mineral deposits (Plates 2-4). Summary descriptions of areas classified MRZ-2a and MRZ-3a are represented on Tables 1-3. Construction sand, gravel, and common rock resources are not considered in this report.

Major findings of this study are:

- A regional-scale fault system forming the structural boundary along the east margin of the Providence Mountains is classified as containing inferred resources of precious and base metals (MRZ-2b). The deposits were formed by hydrothermal processes and are hosted in cavity-filling quartz veins in granitoid rock and as replacement bodies in carbonate strata. Four other areas in the Providence, Granite, and Clipper mountains and the Colton Hills are classified as likely to contain undiscovered mineral deposits of hydrothermal origin (MRZ-3a).
- Four areas in the Providence and Granite mountains are classified as containing either inferred resources or demonstrated subeconomic resources of iron ore formed by contact metasomatic processes (MRZ-2b). These include the areas surrounding the Vulcan Mine-Burro prospects, the Cornfield Springs Consolidated Mine, the Black Jack Mine, and the Iron Victory Mine. Four other areas located in the Providence, Granite, and Clipper mountains and the Colton Hills are classified as likely to contain undiscovered mineral deposits of contact metasomatic origin (MRZ-3a).
- Part of the Kelso Dune Field is classified MRZ-2a for industrial sand resources. About 15 billion tons of marginally economic reserves have been identified. Five areas in the Providence, Old Dad, and Bristol mountains are classified as likely to contain significant industrial mineral deposits (MRZ-3a). These include large areas within which thick sections of Paleozoic carbonate strata (limestone, dolomite, and marble) are exposed and less extensive areas which could contain economic deposits of quartzite, zeolites and perlite. The areas are classified MRZ-3a because no production has occurred in the project area and because adequate information regarding grade of potential resources is lacking.

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PART I – PROJECT DESCRIPTION

INTRODUCTION

Local, State, and federal agencies are faced with difficult decisions as competition for land use increases. Since availability of mineral resources is vital to our society, it is essential that the mineral potential of land be considered in the land-use planning process. The California Surface Mining and Reclamation Act of 1975, as amended, requires the State Geologist to classify land according to the presence, absence, or likely occurrence of significant mineral deposits in specific regions within the State. This information is submitted to the California State Mining and Geology Board which, in turn, transmits it to appropriate local governments which are required to incorporate it into their general land-use plans. The primary objective of mineral land classification is to ensure that the mineral resource potential of land is recognized and considered before land-use decisions that may preclude mining are made.

METHODOLOGY

The Mojave Desert region is one of the geographic regions in California selected for non-urban mineral land classification studies (Figure 1). This study covers the Kerens, Flynn, and Colton Well 15-minute quadrangles which are located in the eastern Mojave Desert region (Figure 2). The study included research of geologic and mining-related literature, compilation of geologic maps, and plotting of reported mines and prospects using publications and mine data of the Division of Mines and Geology, U.S. Geological Survey, U.S. Bureau of Mines, the Bureau of Land Management, and the Southern Pacific Land Company (1959; 1964). It also involved a field work phase which included a site investigation of most of the known mines and mineral prospects, limited sampling of rocks for chemical analyses, geophysical surveys, and limited geologic mapping. This data was then assessed to identify geologic factors which brought about or influenced mineralization.

The field and analytical data were later integrated and evaluated for assigning Mineral Resource Zones (MRZs) to areas in accordance with mineral land classification guidelines adopted by the California State Mining and Geology Board (1983). A geologic map (scale 1:62,500) and mineral land classification maps (scale 1:62,500) were prepared and are included in this report (Plates 1-4). Mine and prospect descriptions are presented in Appendix A.

THE CALIFORNIA MINERAL LAND CLASSIFICATION SYSTEM

The guidelines for mineral land classification established by the California State Mining and Geology Board (1983) have been adapted to the California Mineral Land Classification Diagram (Figure 3). These adaptations are presented below:

The horizontal axis of the California Mineral Land Classification Diagram (Figure 3) portrays the degree of knowledge about mineral resource occurrence while the vertical axis refers to economic characteristics of the deposits. The two major divisions on the diagram are "Identified Resources" and "Undiscovered Resources." The division between the two major "knowledge" categories also marks the division between areas classified MRZ-2 and MRZ-3, wherein areas classified MRZ-2 contain identified mineral resources and areas classified MRZ-3 may contain undiscovered mineral resources.

Mineral Resource Zone (MRZ) Categories

Mineral Resource Zone categories set forth in the guidelines for mineral land classification established by the California State Mining and Geology Board (1983) have been adapted to the California Mineral Land Classification Diagram (Figure 3). These adaptations are presented below.

MRZ-1: Areas where geologic information indicates there is little likelihood for the presence of mineral resources.

MRZ-2a: Areas that contain significant measured or indicated reserves.

MRZ-2b: Areas where geologic information indicates that significant inferred resources or demonstrated subeconomic resources are present.

MRZ-3a: Areas likely to contain undiscovered mineral deposits similar to known deposits in the same producing district or region (hypothetical resources).

MRZ-3b: Areas judged to be favorable geologic environments for mineral resource occurrence, but where mineral discoveries have not been made in the region (speculative resources).

MRZ-4: Areas where geologic information does not rule out either the presence or absence of mineral resources.

Mineral land classification addresses specific types of mineral deposits that are found to occur or are likely to occur in the project area. The type of mineral deposit for which a particular area is classified is denoted by a superscript letter following the assigned MRZ category (e.g., MRZ-2b$^{(h)}$ for deposits formed by hydrothermal processes). Also, superscript reference numbers are used to identify specific MRZ areas discussed in the report (e.g., MRZ-2b$^{(h\text{-}2)}$).

Summary Of Mineral Resource Zone Assignments

Assignment of mineral resource zones is based on a geologic and mineral resource survey that was conducted during the course of this study (see Parts II and III). As discussed in Part II, the survey shows that at least three types of mineral deposits are present, or are likely to be present, in the study area. These are: (1) deposits formed by hydrothermal processes that contain base and precious metals (denoted by the superscript letter "h"); (2) industrial minerals, which include industrial sand, limestone, dolomite, marble, perlite, and zeolites (denoted by the superscript letter "i"); and (3) deposits formed by

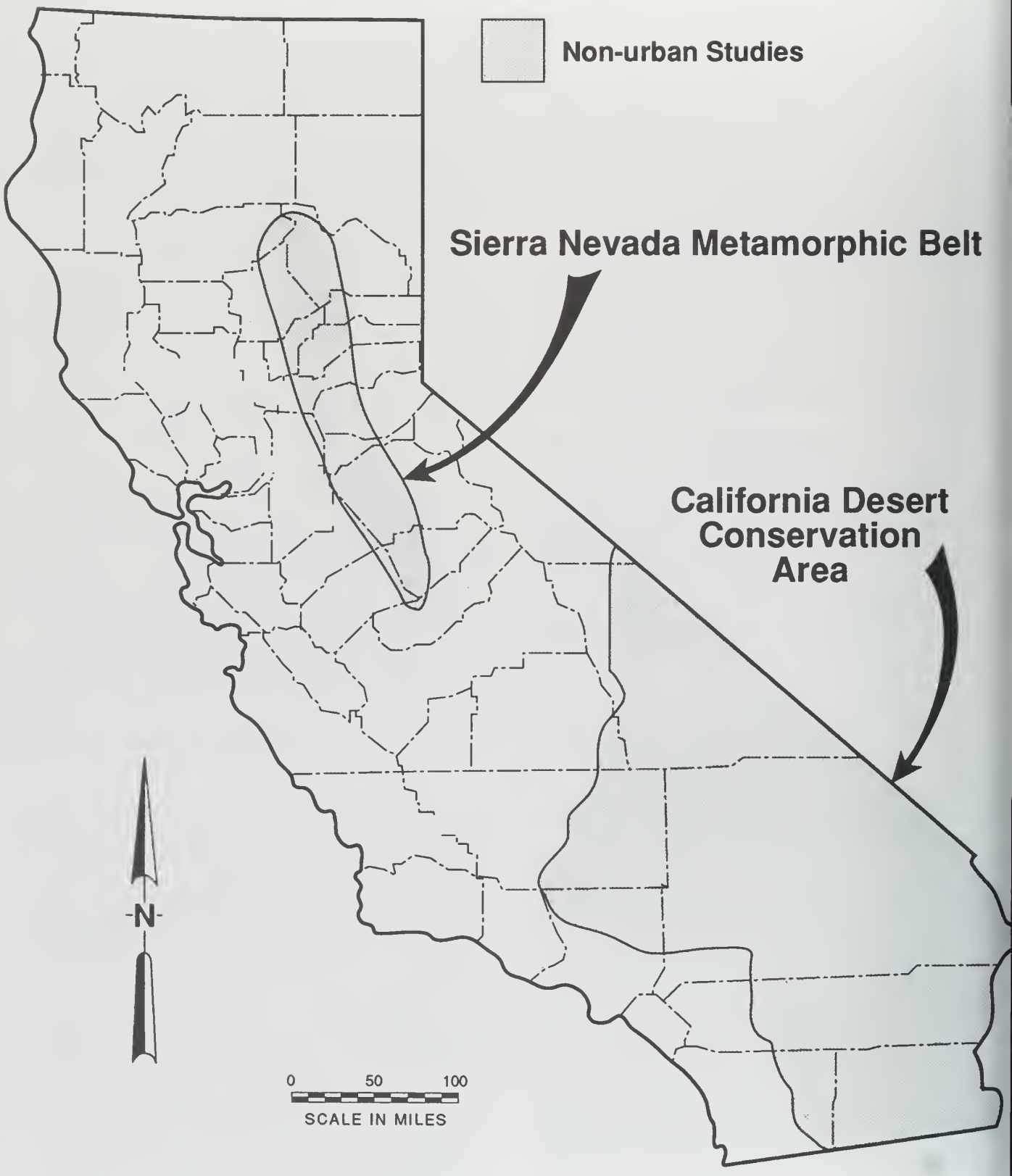

Figure 1. Map of California showing non-urban areas of the State subject to mineral land classification.

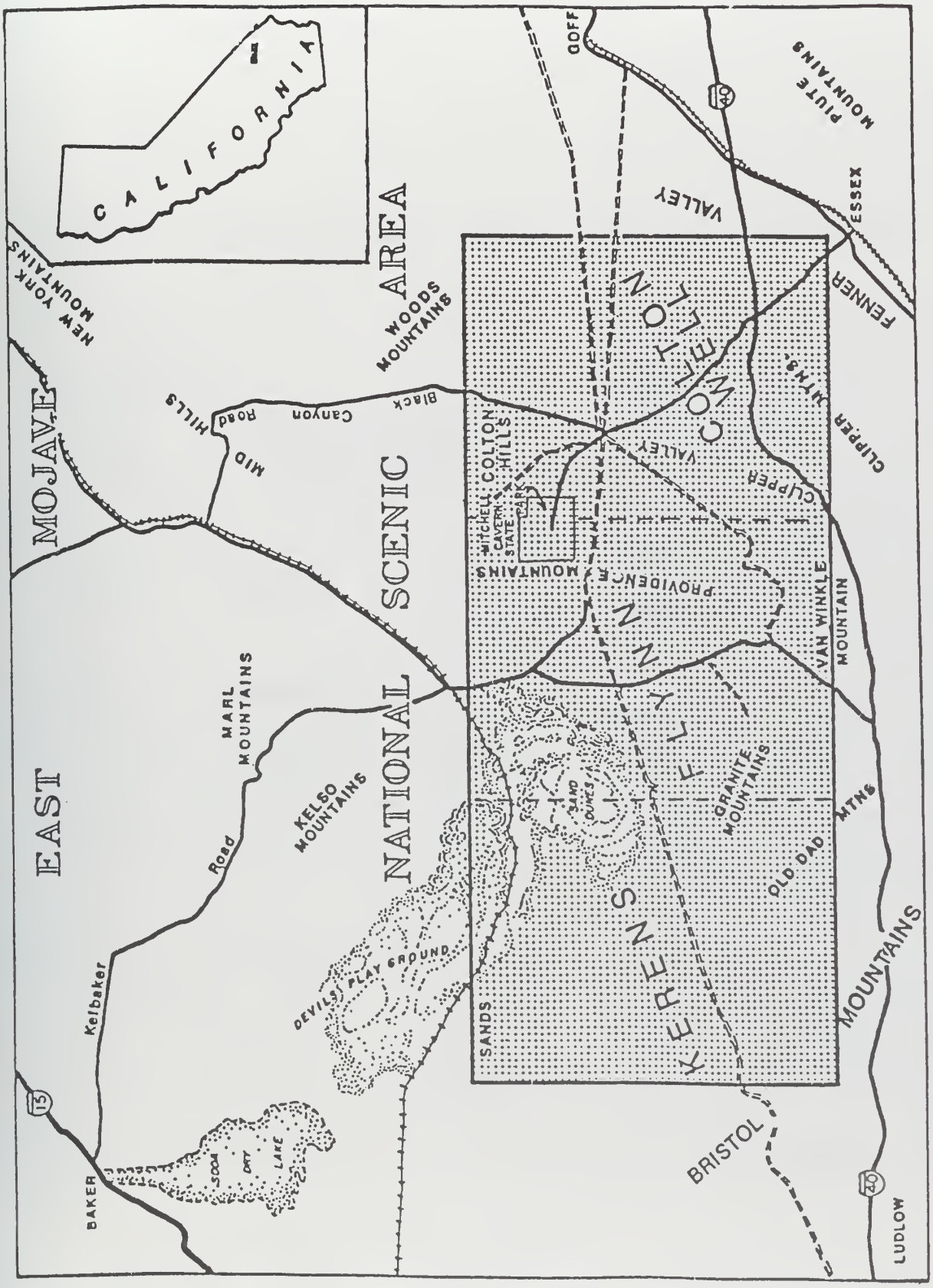

Figure 2. Location map of the Kerens, Flynn and Colton Well 15-minute quadrangles.

contact metasomatism (skarns) which contain iron, copper, and associated metals (denoted by the superscript letter "s"). Placer gold deposits are not addressed.

Individual areas classified MRZ-2a, 2b and MRZ-3a, 3b with respect to the above types of deposits are presented on Plates 2-4 and described in detail in the Mineral Resource Assessment section of this report (Part III). For convenience, these are summarized in tabulated form on Tables 1-3, which follow.

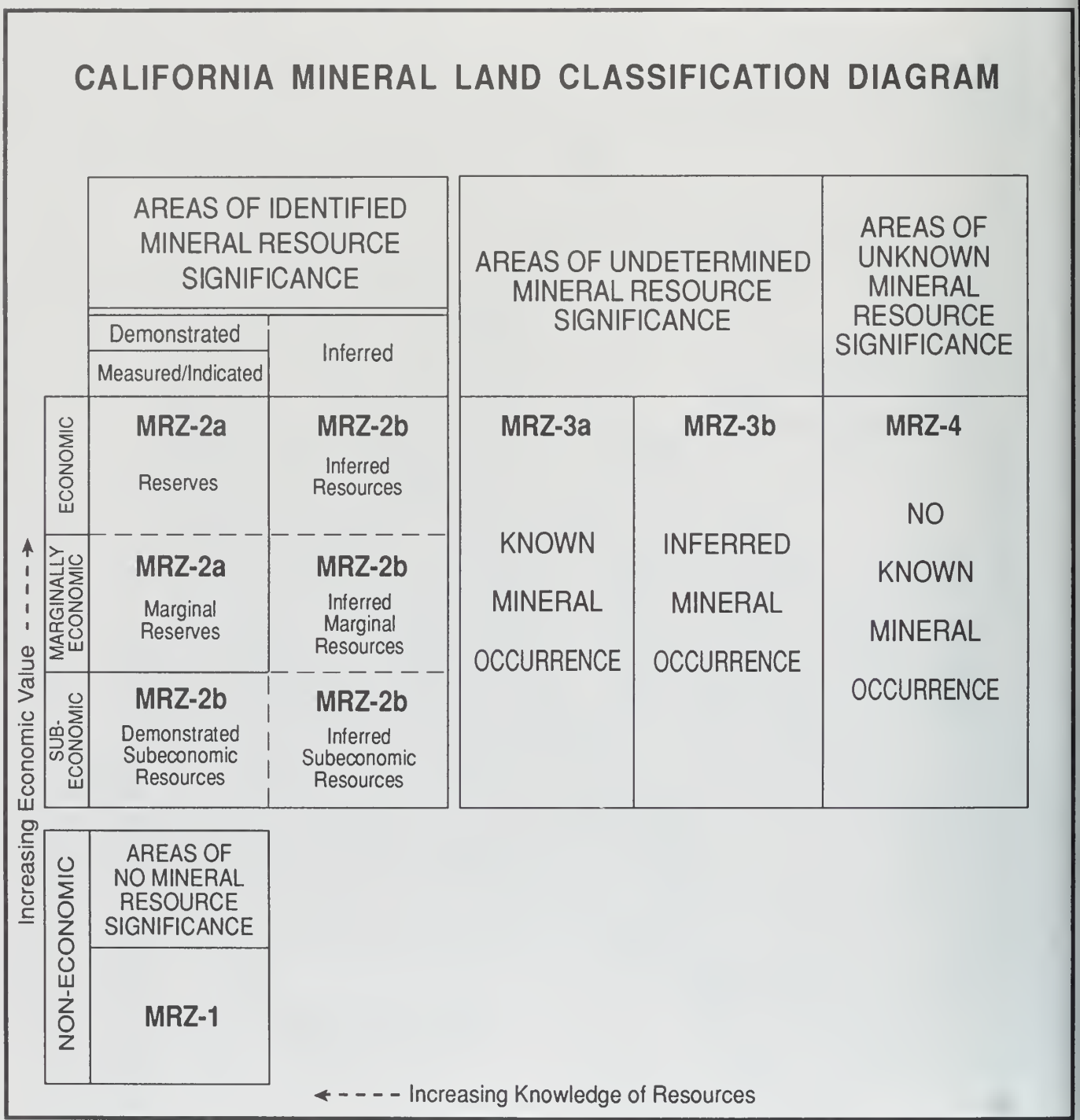

Figure 3. California Mineral Land Classification Diagram: Diagrammatic relationship of mineral resource zone categories to the resource/reserve classification system. See Appendix A for explanation of nomenclature.

TABLE 1. SUMMARY LISTING OF AREAS CLASSIFIED MRZ-2 AND MRZ-3 FOR DEPOSITS FORMED BY HYDROTHERMAL PROCESSES (SEE PLATE 2).

RESOURCE ZONE	NAME/ VICINITY	15' QUAD(S)	RESERVES/ RESOURCES	SUPPORTING EVIDENCE FOR MRZ ASSIGNMENT*
MRZ-2b(h-1)	East Providence Mountains	Flynn/ Colton Well	Inferred base and precious metal resources.	Historic gold, silver, and lead production has occurred from mines located along a regional scale fault system extending along the eastern margin of the Providence Mountains. Exploration drilling, geochemical sampling, widespread evidence of hydrothermal alteration, and continuity of system strongly suggest that additional resources are present.
MRZ-3a(h-1)	Central/ Western Providence Mountains	Flynn	Moderate to high potential for presence of undiscovered base and precious metal resources.	Limited base and precious metal production from historic mining activity, localized hydrothermal alteration of country rock, and geochemical sampling of mines, prospects, and stream sediments indicate area is likely to contain deposits of base of precious metals localized along major faults and shear zones.
MRZ-3a(h-2)	Colton Hills	Colton Well	Moderate to high potential for presence of undiscovered base and precious metal resources.	Probable production of small amounts of gold from historic mining in the area, evidence of localized hydrothermal alteration of country rock, and geochemical sampling of mine and prospect localities and stream sediments indicate area is likely to contain deposits of base and precious metals localized along small scale faults in Precambrian basement rock.
MRZ-3a(h-3)	Clipper Mountains	Colton Well	Moderate to high potential for presence of undiscovered base and precious metal resources.	Probable production of small amounts of gold from historic mining in the area, evidence of localized hydrothermal alteration of country rock, and geochemical sampling of mine and prospect localities and stream sediments indicate area is likely to contain deposits of base and precious metals localized along small scale faults in Precambrian basement rock.
MRZ-3a(h-4)	Granite Mountains	Kerens/ Flynn	Moderate to high potential for presence of undiscovered base and precious metal resources.	Probable production of small amounts of base and precious metals, evidence of localized hydrothermal alteration of country rock, and geochemical sampling indicate area is likely to conatin deposits of base and precious metals localized along faults extending along the north and east margins of the range.

*Refer to descriptions of specific Mineral Resource Zones in Part III of text for detailed discussions of supporting evidence.

TABLE 2. SUMMARY LISTING OF AREAS CLASSIFIED MRZ-2 AND MRZ-3 FOR DEPOSITS FORMED BY CONTACT METASOMATISM.

RESOURCE ZONE	NAME/ VICINITY	15' QUAD (S)	RESERVES / RESOURCES	SUPPORTING EVIDENCE FOR MRZ ASSIGNMENT*
MRZ-2b(s-1)	Vulcan mine/ Burro prospects- Providence Mountains	Flynn	Inferred iron ore resources totalling 3.3 million long tons.	U.S. Bureau of Mines mineral resource evaluation, Providence Mountains Wilderness Study Area (CDCA 262).
MRZ-2b(s-2)	Cornfield Spring	Flynn	Inferred iron ore resources totalling 110,000 long tons.	U.S. Bureau of Mines mineral resource evaluation, Providence Mountains Wilderness Study Area (CDCA 262).
MRZ-2b(s-3)	Black Jack Mine Area- Providence Mountains	Flynn	Subeconomic demonstrated iron ore resources totalling 230,000 long tons.	U.S. Bureau of Mines mineral resource evaluation, Providence Mountains Wilderness Study Area (CDCA 262).
MRZ-2b(s-4)	Iron Victory Mine Area- Granite Mountains	Flynn	Inferred iron ore resources totalling 110,000 long tons.	U.S. Bureau of Mines mineral resource evaluation, Bristol/Granite Mountains Wilderness Study Area (CDCA 256).
MRS-3a(s-1)	Northern Providence Mountains	Flynn	Moderate to high potential for presence of undiscovered iron ore resources.	This area encompasses the contact zone between carbonate strata and plutonic rock along which known skarn deposits, with inferred resources and demonstrated subeconomic resources, exist. Small pods and lenses of magnetite exposed within the zone and geophysical surveys indicate additional resources at depth.
MRZ-3A(S-2)	Colton Hills	Colton Well	High potential for presence of undiscovered iron resources.	Exposure of small pods of magnetite and a large magnetic anomaly centered over the alluvial valley near the 7IL Ranch indicate the likely presence of iron ore resources.
MRZ-3a(s-3)	Granite Mountains	Flynn	Moderate potential for presence of undiscovered iron and tungsten resources.	A group of small roof pendants in plutonic rock show evidence of contact metasomatism. One small skarn zone has been mined, but no production reported. Geochemical sampling of stream sediments show anomalous amounts of tungsten possibly originating from local skarn deposits.
MRZ-3a(s-4)	Clipper Mountains	Colton Well	Moderate to high potential for presence of tungsten resources.	Small amounts of tungsten ore were produced from two tactite zones developed in carbonate roof pendant in plutonic stock. Additional resources could exist.

*Refer to descriptions of specific Mineral Resource Zones in Part III of text for detailed discussions of supporting evidence.

TABLE 3. SUMMARY LISTING OF AREAS CLASSIFIED MRZ-2 AND MRZ-3 FOR INDUSTRIAL MINERAL DEPOSITS (SEE PLATE 4).

RESOURCE ZONE	NAME/ VICINITY	15' QUAD (S)	RESERVES / RESOURCES	SUPPORTING EVIDENCE FOR MRZ ASSIGNMENT*
MRZ-2a(i-1)	Kelso Dune Field	Kerens/ Flynn	15 billion tons of marginally economic industrial sand reserves.	Reserves established in U.S. Bureau of Mines/U.S. Geological Survey mineral resource evaluation of Kelso Dunes Wilderness Study Area (CDCA 250).
MRZ-3a(i-1)	Providence Mountains	Flynn	Moderate to high potential for presence of undiscovered limestone resources.	A 5000-foot-thick section of Middle Devonian to Lower Triassic carbonate strata composed predominantly of limestone is exposed over a wide area in the northern half of the Providence Mountains. Although there has been no production elsewhere in the Mojave Desert province and, as a consequence, this area could contain important limestone resources.
MRZ-3a(i-2)	Providence Mountains	Flynn	Moderate to high potential for presence of undiscovered dolomite resources.	A 5000-foot- thick section of Lower Cambrian to Middle Devonian carbonate strata composed predominantly of dolomite is exposed over a wide area in the northern half of the Providence Mountains. Carbonate rocks of equivalent ages have produced dolomite in other areas of California and the western United States and, as a consequence, these areas could contain significant dolomite resources.
MRZ-3a(i-3)	Providence Mountains	Flynn	Moderate potential for presence of undiscovered quartzite resources	Quartzite deposits exposed along western margin of northern Providence Mountains are identified as potential quartzite resources in California Division of Mines and Geology Bulletin 187 - "Quartzite in California".
MRZ-3a(i-4)	Bristol/ Old Dad Mountains	Kerens	Moderate to high potential for presence of undiscovered perlite and zeolite resources.	Area contains altered tuff beds which, in at least one locality, contain the zeolite minerals clinoptilolite, mordenite, and phillipsite. Also present in the areas classified MRZ-3a(i-4) are vitrophyric volcanic flows which locally could exhibit perlitic structure. Perlite has been mined from a vitrophyric volcanic deposit less than a mile south of the project area.
MRZ-3a(i-5)	Van Winkle Mountain	Flynn	Moderate potential for presence of undiscovered perlite resources.	Ten-to 30-foot-thick vitrophyric volcanic flow deposits could locally exhibit perlitic structure. Although no production has occurred from this area, the deposits are similar to those which have been mined in the Bristol Mountains.

*Refer to descriptions of specific Mineral Resource Zones in Part III of text for detailed discussions of supporting evidence.

PART II - SUPPORTING INFORMATION FOR MINERAL RESOURCE ASSESSMENT

GEOGRAPHIC SETTING

The study area consists of about 730 square miles of land in the eastern Mojave Desert region of San Bernardino County between latitude 34°45' and 35°00' north and longitude 115°15' and 116°00' west (Figure 2). About 35 percent of the area is composed of rocky terrain that makes up the Bristol, Old Dad, Granite, Providence, Van Winkle, and Clipper mountains and the less rugged Colton and Blind hills. Another 10 percent of the area is covered by eolian sand deposits of the Kelso Dune field. The remaining area is comprised of sandy basin and wash terrain.

Elevations range from about 1,280 feet in the northwest part of the area (Kelso Wash) to 7,171 feet in the Providence Mountains. The temperature generally varies between near zero degrees Fahrenheit in the winter to over 110 degrees Fahrenheit in the summer and the annual rainfall usually ranges between 1 and 7 inches.

Vegetation consists of sparse pinon pine, juniper, and scrub oak at higher elevations while at lower elevations abundant creosote bush, cacti, and scattered yucca are present. Most of the area is open to cattle grazing through lease land to ranchers by the Bureau of Land Management.

Principal access into the area is via Kelbaker Road, which connects Interstate Highways 15 and 40, and Essex Road, which extends northeast from I-40 to Mitchell Caverns State Park and southeast to Essex. Secondary roads include an east-west power line/gas line maintenance road, the Vulcan Mine Road/Foshay Pass, 7IL Ranch Road, and Black Canyon Road. A few jeep trails extend from the primary and secondary roads into mountainous areas.

About two-thirds of the study area is included in the East Mojave National Scenic Area administered by the Bureau of Land Management. Also located within the project boundaries is the Providence Mountains State Recreational Area (Mitchell Caverns State Park) administered by the California Department of Parks and Recreation.

GEOLOGY

Previous Work

The general geology of the study area has been described by Thompson (1929), Clark (1921), Hazzard and Mason (1936), Hazzard (1937; 1954), Emery and Easton (1951), Sharp (1966; 1978; 1982), Stein and Warrick (1979), Casey (1981), Miller and others (1982), Lukk (1982), Stone and others (1983), and Glazner and others (1986).

Most recent-year geologic work within the project area has been related to Wilderness Study Area (WSA) suitability investigations conducted by the U.S. Bureau of Land Management, the U.S. Bureau of Mines, and the U.S. Geological Survey. These studies evaluate mineral resources and mineral resource potential in the Providence Mountains WSA (Vredenburgh, 1982; Moyle and others, 1986; Folger and others, 1986), the Southern Providence Mountains WSA (Miller and others, 1985; Detra and others, 1984; Munts, 1984), the Bristol-Granite Mountains WSA (Sabine, 1984; Detra and Kilburn, 1985) and the Kelso Dunes WSA (Yeend and others, 1984; Munts, 1983).

The geologic map which accompanies this report (Plate 1) has been compiled and modified from geologic maps made by Hazzard (1954), Southern Pacific Company (1959), Kupfer and Bassett (1962), Bassett and Kupfer (1964), Casey (1981), Lukk (1982), Miller and others (1985), Miller and others (unpublished) and Howard and others (in publication).

Lithology

Major lithologic units exposed in the project area include Precambrian crystalline basement rock, a sequence of Paleozoic and Mesozoic epicontinental deposits, Mesozoic plutonic and volcanic rocks, and Cenozoic volcanic and sedimentary deposits.

Precambrian Rocks

Exposure of gneiss, schist, and amphibolite of Precambrian age occur in the Providence and Clipper mountains. These rocks crop out at lower elevations, are typically moderately to highly weathered, and commonly show effects of hydrothermal alteration near intrusive contacts and along traces of fault and shear zones.

Paleozoic-Mesozoic Sedimentary and Metamorphic Rocks

Unconformably overlying the Precambrian basement rocks in the northern Providence Mountains is a 10,000-foot-thick section of Paleozoic and Lower Triassic strata comprised predominantly of limestone and dolomite, but including quartzite, shale, and sandstone (Plate 1). The Paleozoic sequence has been divided into ten formations by Hazzard (1954). From youngest to oldest, these are the Moenkopi, Birdspring, Monte Cristo, Sultan, an unnamed Upper Cambrian unit (Nopah), Bonanza King, Cadiz, Chambless, Latham Shale, and Prospect Mountain Quartzite. Small isolated exposures and roof pendants of these units crop out in the Bristol, Granite, and Clipper mountains.

Mesozoic Igneous Rocks

Mesozoic plutonic rocks are widely exposed in the Granite, Providence, and Bristol mountains, as well as the Colton Hills and to a limited extent in the Old Dad and Clipper mountains. Most of the intrusives are quartz diorite to quartz monzonite. Miller and others (1982) divide the Mesozoic plutonic rocks of the region into an older (Jurassic) suite characterized by a high color index, lavender, grey, or pink alkali feldspar, and clots of mafic minerals, and a younger (Cretaceous) suite typified by a low color index, white to flesh-colored feldspars, and dissemi-

nated mafic minerals. In addition, Howard and others (in progress) interpret hornblende quartz diorite gneiss and hornblende quartz monzodiorite gneiss exposed in the Granite Mountains to be of probable Triassic age.

Isolated exposures of andesitic volcanic and hypabyssal rocks of probable Jurassic age crop out at the southern tip of the Providence Mountains and in the northern Bristol Mountains (Plate 1). These rocks are fine-grained, dark green to black, altered, and highly fractured.

Cenozoic Volcanic and Sedimentary Rocks

Thick sections of Tertiary volcanic rocks are exposed in the Bristol, Old Dad, Van Winkle, and Clipper mountains. Volcanic rocks also form the mesas of the Woods Mountains and Colton Hills along the northeast margin of the project areas as well as the Blind Hills (Plate 1). The volcanic terranes of the Bristol and Old Dad mountains are characterized by a wide variety of rock types of limited lateral extent due in part to faulting coeval with deposition (Miller and others, 1982). Major lithologic units include: andesite basalt flows and breccia; tuff, water-lain tuff breccias, and welded tuff; volcanic sediments; and banded rhyolite flows and vitrophyric deposits. The welded tuff unit which caps the 7,000-foot volcanic section has been tentatively correlated with early Miocene Peach Springs tuff (Glazner and others, 1986).

Volcanic sequences exposed in the Clipper Mountains and Colton Hills area are less complex, stratigraphically and structurally, than those of the Bristol and Old Dad mountains. The Clipper Mountain section consists of 300 or more feet basal tuff overlain by 700 or more feet of andesitic basalt. Locally, welded tuff caps the section. Volcanic rocks exposed to the north in the Blind Hills, Colton Hills, and Woods Mountains, as well as isolated exposures in Fenner Valley, are principally felsic tuffs and welded tuffs. The volcanic section exposed on Van Winkle Mountain is similar to the Clipper Mountains section.

Structure

Two distinct tectonic provinces are present within the central Mojave Desert. The provinces, variously referred to as the Mojave and Sonoran tectonic blocks (Miller and others, 1982), are separated along a series of en echelon sedimentary troughs extending southeasterly along the projected continuation of the Death Valley fault zone. The Mojave block lies to the west and is characterized by numerous northwest-trending strike slip faults, active seismicity, intermediate heat flow, and thicker crust. The Sonoran tectonic block lies to the east and is characterized by northerly trending basin and range-type faulting, low seismicity, thinner crust, and higher heat flow (Miller and others, 1982; Fuis, 1961; Lachenbruch and Sass, 1981).

Within the project area, the Bristol and Old Dad mountains exhibit a structural style somewhat characteristic of the Mojave block while the Providence Mountains exhibit basin and range-type features associated with the Sonoran block. Whether a boundary or a transition zone between the two tectonic provinces extends through the project area is unknown.

Major faults in the project area include: (1) the Bristol Mountains fault which trends northwest, dips 50 to 80 degrees northeast and shows reverse separation (Davis, 1973; Howard and others, in progress); (2) the Bull Canyon fault, westerly trending, low angle normal fault extending along the northern base of the Granite Mountains; (3) the Hidden Mill fault, a northerly trending, high angle fault cutting across the southern Providence Mountains and apparently continuing along the western margin of the northern Providence range; and (4) the northerly trending Big Horn and East Providence faults, high angle reverse faults extending along the eastern base of the Providence Mountains. Most of the mines and prospects in the project area lie along the Hidden Hill, Big Horn, and East Providence faults.

GEOPHYSICAL DATA

Airborne and ground magnetic surveys can be effectively used to aid in the evaluation of areas for mineral resources. Magnetic surveys are for locating ore deposits that contain the mineral magnetite and, to a lesser extent, the mineral pyrrhotite. They also can be used to explore for non-magnetic ore deposits that are associated with host rocks containing magnetic materials. In addition, magnetic surveys are often an excellent tool for delineating subsurface structural features such as faults that may relate to mineral deposition processes.

An aeromagnetic map of the Needles 1° by 2° quadrangle (U.S. Geological Survey, 1981) includes aeromagnetic coverage of the Kerens, Flynn, and Colton Well 15-minute quadrangles comprising the study area of this report. This map and a geologic map of the Needles Sheet (Bishop, 1963) were used to visually interpret local aeromagnetic anomalies in the study area. From this initial search, five positive aeromagnetic anomalies were selected for further investigation. (A discussion of the aeromagnetic anomalies over the southern Providence Mountains located in the central part of the study area can be found in Miller, and others, 1984.)

The approximate locations of the selected aeromagnetic anomalies are shown in Appendix D on Figure 1. The U.S. Geological Survey has recently published 7.5-minute topographic quadrangle maps for the three 15-minute quadrangle maps of this report. Appendix D, Figure 1 shows the locations of the new maps.

Three of the five anomalies selected for ground tests are primarily centered over exposures of alluvial deposits where the cause of the anomaly is hidden beneath the sediments (aeromagnetic anomalies F, L, and W). Aeromagnetic anomaly V is situated over the Vulcan mine (iron ore) and aeromagnetic anomaly B is centered over a ridge of Precambrian gneissic rocks. In all, about 12 miles of ground magnetic traverses were obtained in the field to test the aeromagnetic anomalies. In addition, two ground magnetometer lines, totaling about 5.5 miles in length, were obtained along the eastern front of the Providence Mountains (Appendix D, Figure 1, Lines V-15 and V-16).

A detailed discussion of the magnetic investigations performed for this report is presented in Appendix D. In summary, an area east of the old Vulcan iron-ore mine (aeromagnetic anomaly V, Fountain Peak 7.5-minute quadrangle) was found to contain exposed skarn deposits sometimes exhibiting reversed magnetism (negative anomalies) as well as concealed or buried rocks causing positive magnetic anomalies which are interpreted as magnetite-bearing skarn deposits with normal magnetism. Ground

investigations of aeromagnetic anomaly L, near the 7IL Ranch on the Colton Well 7.5-minute quadrangle, indicate that the anomaly probably is caused by an unexposed, relatively large, magnetite-bearing body. The deposit is buried beneath alluvium and may be of economic interest. Three other aeromagnetic anomalies were found to be caused by rocks of little or no economic interest. The two ground magnetic traverses conducted across the eastern front of the Providence Mountains demonstrate that at least some faults that are concealed beneath the alluvium east of the mountains have a detectable magnetic signature.

GEOCHEMICAL DATA

A geochemical survey of limited extent was conducted within the project area during the course of this study. Forty-nine stream sediment samples (-80 mesh sieve), several heavy mineral (pan) separates, and 31 chips and grab samples from prospect and mine sites were collected and analyzed for 30 element abundance by inductive coupled plasma (ICP) and for gold content by atomic absorption (A.A.). Rock samples collected from prospects and mines were samples that appeared to represent highly mineralized rock. They are not intended to provide an average metal content for the property examined, but rather to provide information regarding presence and nature of mineralization. Results of the geochemical analyses are presented in Appendix C.

PART III - MINERAL RESOURCE ASSESSMENT

MINING HISTORY

Mining activity in the region dates to 1863 when silver was discovered in the northern Providence Mountains-Mid Hills area. Mining in this isolated part of the Mojave Desert region during the 1860s and 1870s was generally small-scale with only the richest, near-surface ore bodies developed. This mainly was due to the high cost of shipping ore and concentrate overland by wagon (Lorey, 1985). A second notable period of prospecting and mining activity in the region followed discovery of rich silver-lead ore in 1882 at the Bonanza King mine located along the eastern slope of the Providence Mountains (Trojan district). Production between 1882 and 1887 is reported to have been valued at about $1.8 million (The Mining World, February 6, 1906, p. 225).

Lode gold deposits were discovered in the southern Providence Mountains (Arrowhead district) in 1862. However, mining and prospecting activity didn't peak in the area until the early 1900s following completion of the Santa Fe and Union Pacific railroads. Ore bodies were generally small, but rich, leading to sporadic and short-lived operations. Total gold production for the area is reported to have been fewer than 9,000 ounces (Miller and others, 1985). The more productive mines were the Big Horn and Hidden Hill mines. Small amounts of gold also were produced in the Colton Hills (Trojan district) and the Clipper Mountains (Gold Reef district).

Iron occurring in skarn deposits was discovered in the region around the turn of the century. Significant production took place between 1942 and 1947 when Kaiser Steel extracted 2.6 million long tons of blast-furnace-grade iron ore from the Vulcan mine (Wright and others, 1953). About 1,200 tons of magnetite was produced from sand mined from the Kelso Dune field in the early 1970s (Yeend and others, 1984).

A small amount of tungsten ore was produced from the Clipper Mountain Tungsten mine (#104) in the early 1950s (Wright and others, 1953). Decorative rock has been mined for test purposes from the Ribbon Rock (marble) mine located in the southwest corner of the project area.

Although several hundred claims in the project area are actively held at present time, no production or development work is in progress. Exploration drilling, however, was performed at the Bonanza King mine during the late 1970's and early 1980s (Moyle and others, 1986).

Additional reference on mines and mineral production in the project area include DeGroot (1890) and Bailey (1904) covering the early mining history of the region. Tucker (1920, 1921, 1924) and Tucker and Sampson (1930, 1931, and 1943) provide accounts of mining activity after the turn of the century. Wright and others (1953), Goodwin (1957), Clark (1970), Vredenburgh and others (1981), Vredenburgh (1982), Stein and Warrick (1979), Munts (1984), Sabine (1984), and Moyle and others (1986) summarize the mining history of the region.

MINERAL LAND CLASSIFICATION

The Kerens, Flynn, and Colton Well 15-minute quadrangles are classified for the presence or likely occurrence of metallic and industrial mineral resources. Consideration is given to all non-fuel minerals of economic importance (exclusive of sand, gravel, and common rock) by determining what genetic classes of mineral deposits (Table 4) are likely to exist in the area. Only those genetic classes for which direct or indirect evidence indicates presence or likely occurrence of significant deposits are addressed in the mineral land classification report. However, there may exist other types of deposits which, because of lack of evidence, are not presently recognized.

Of the ten genetic classes listed in Table 4, three are judged to be, or likely to be, present in the project area. These are as follows:

1. Deposits formed by hydrothermal processes (base and precious metals) - Plate 2.

GENETIC CLASSES OF ORE DEPOSITS
1. Magmatic concentration deposits
2. Contact metasomatic deposits
3. Hydrothermal mineral deposits (exclusive of volcanogenic deposits)
4. Exhalative volcanic deposits (volcanogenic)
5. Deposits formed by sedimentation
6. Deposits of bacteriogenic origin
7. Evaporates
8. Residual and mechanical concentrations
9. Deposits formed by metamorphism
10. Industrial mineral deposits formed by diverse processes

Table 4. Genetic classes of ore deposits. Mineral land classification is based on recognition and delineation of geologic environments present in an area and determination of those genetic types of mineral deposits likely to be hosted in those environments. In all, ten distinct genetic types of mineral deposits are recognized worldwide.

2. Deposits formed by contact metasomatism (iron tungsten, and associated metals) - Plate 3.
3. Industrial mineral deposits formed by diverse processes (industrial sand, carbonate rock, quartzite, perlite and zeolites) - Plate 4.

AREAS CLASSIFIED FOR DEPOSITS FORMED BY HYDROTHERMAL PROCESSES

Ore deposits formed by hydrothermal processes represent a major source of metallic mineral resources and to a lesser extent, non-metallic ones. The metals include: gold, silver, lead, zinc, copper, mercury, antimony, tin, tungsten, molybdenum, vanadium, and numerous minor elements. Of greatest economic significance in the present study area is gold and silver.

Evidence of hydrothermal mineralization is widespread in the study area. Some areas of hydrothermal mineralization show considerable continuity and are, therefore, attractive exploration targets. These areas are identified by characteristic hydrothermal mineral assemblages that have been localized along regional-scale fault and shear zones.

Mineral land classification of the Kerens, Flynn, and Colton Well quadrangles with respect to hydrothermal mineralization is presented on Plate 2. Mineral resource zones for hydrothermal deposits are denoted by the superscript "h" (e.g., MRZ-3a$^{(h)}$). For purposes of discussion, individual classified areas are assigned reference number (e.g., MRZ-3a$^{(h-1)}$).

Areas Classified MRZ-2b$^{(h)}$

Land classified MRZ-2b$^{(h)}$ are areas where geologic information indicates that significant inferred resources of hydrothermal origin are present. One area within the project boundary has been classified MRZ-2b$^{(h)}$.

MRZ-2b $^{(h-1)}$-Providence Mountains: Vein-hosted base and precious metal deposits of hydrothermal origin are localized along a series of northerly trending faults extending along the eastern margin of the Providence Mountains. The fault system, which includes the Big Horn, the East Providence, the southern end of the Hidden Hill faults, as well as associated parallel and cross cutting faults and fractures (Plate 1), acted as conduits for mineralized hydrothermal fluids most likely related to late-stage cooling of Jurassic plutons. Most base and precious metal production within the project area have come from mines located along this structural zone. Mines with recorded production are the Hidden Hill, Coarse Gold, Big Horn, Buena Vista, Providence, Pilot, Silver King, and most notably, the Bonanza King (see Mining History and Appendix A).

Deposits north of Foshay Pass are characterized by high silver-lead content while those to the south are normally rich in gold and copper. The contrasting ore body mineralogies may be attributed to differing host rocks (reactive carbonate rock to the north and granitoid rock to the south) and possibly because Au-Cu enriched deposits in the southern Providence Mountains represent ore deposition at deeper levels along the fault system (Miller and others, 1985).

In the southern Providence Mountains, gold-copper bearing veins exposed along segments of the Big Horn fault trend northerly, dip steeply either to the east or west, and vary from stringer to massive, grey to milky white quartz masses measuring over 10 feet wide. Veins exposed along the segment of the Hidden Hill fault included in MRZ-2b$^{(h-1)}$ are similar, but dip gently (30 to 50 degrees) to the west. Both sets of quartz veins are locally brecciated and cemented by additional quartz and calcite. Other vein gangue minerals include fluorite, ankerite, epidote, chlorite, specularite, and limonite. Sulfides are rarely observed along the oxidized surface exposure of the veins, but samples examined at several dump sites contained pyrite, arsenopyrite, chalcopyrite, galena, and sphalerite. A third series of mineralized quartz veins trending east-west and dipping steeply to the south are exposed west of the Big Horn fault in the vicinity of the Big Horn mine (locality # 71, Plate 2). Gold production has occurred from at least one of these (Contention mine of Big Horn group) and several others have been prospected.

Intensity of alteration of the host rock varies considerably along the mineralized fault zones. Pronounced alteration along the veins is usually confined to zones fewer than 10 feet or so to either side and normally includes propylitization, albitization, silicification, and bleaching of the host rock.

North of Foshay Pass, silver-lead deposits are localized along the East Providence and associated faults, mainly as replacement bodies in brecciated carbonate rock. The breccia zones measure up to 600 feet wide, with principal ore zones having been developed at or near intersections of the East Providence fault and west-trending fault, shear, and fracture zones. The breccia zones are commonly cemented by quartz-calcite and locally silicified. Important ore minerals are argentite and argentiferous galena, but also commonly present are sphalerite, pyrite, and a variety of associated carbonate, oxide chloride, bromide, and sulfate minerals (see mine descriptions, Appendix A).

Mining history, geochemical survey results, exploration drilling at the Bonanza King mine, and the continuity of a mineralized structure of regional scale lead to the conclusion that additional significant base and precious metal resources can be inferred to exist along the east margin of the Providence Mountains.

Areas Classified MRZ-3a$^{(h)}$

Lands classified MRZ-3a$^{(h)}$ are judged likely to contain undiscovered hydrothermal deposits similar to known deposits in the same producing district or region. Four areas have been classified MRZ-3a$^{(h)}$.

MRZ-3a $^{(h-1)}$-Providence Mountains: Base and precious metals deposits of hydrothermal origin are localized along several northerly and southeasterly trending faults in the central and western parts of the Providence Mountains (Plates 1 and 2). The deposits are typically small, irregular ore bodies hosted in quartz veins and are rich in gold, with minor copper, silver, lead, zinc, and molybdenum. The faults, which include most of the Hidden Mill fault in the southern Providence Mountains and its probable extension to the north, acted as conduits for mineralized hydrothermal fluids most likely related to late stage cooling of Jurassic plutons. Pronounced hydrothermal alteration of host rock is typically confined to a zone extending only a few feet to either side of the veins. These zones are commonly marked by intense propylitization where mafic minerals are replaced by chlorite and epidote has developed on fracture surfaces. Locally, the wall rock is silicified and

bleached white. Specularite was noted on fracture surfaces at several localities. A majority of samples collected from mines and prospects along or in the immediate vicinity of these major structures contained values of gold, silver, and base metals (see Munts, 1984, for sample analyses). The zone also includes the Rex mine, which has a small amount of recorded gold production (Plate 2, locality #18; Appendix B).

As discussed in Miller and others (1985), the presence of molybdenum, together with several alteration, mineralogical, and host rock features associated with the Jurassic granitoids exposed in the southern Providence Mountains also may indicate the presence of a gold-rich copper porphyry system. However, at the surface no ore-grade or near ore-grade mineralization is apparent, extensive fracturing and wide spread quartz veining is lacking, and alteration/mineralogical zonation is not evident. Additional work in this area may lead to discovery of porphyry-type mineralization at depth.

MRZ-3a $^{(h-2)}$-Colton Hills: Precious and base metal deposits of hydrothermal origin have been mined and prospected in the Colton Hills area. The deposits appear to be small localized occurrences hosted in quartz veins and shear zones which cut the felsic and mafic granitoid terrain. Most of the workings are in the central and western part of the Colton Hills where fracture and fault filling quartz veins occur in spatial association with a series of prominent, northwest striking, steeply dipping felsic dikes. The veins are typically milky white, locally brecciated quartz, which trend either northwest or northeast. Smaller, east-west oriented veins intersect these in places. The veins locally contain disseminated pyrite, visible galena, and traces of secondary copper minerals. A grab sample of quartz collected from the Grande 1-7 mine (locality #89) contained 0.33 oz per ton gold, 6 oz per ton silver, and 1.8 percent lead (Appendix C, sample 48-v). Vredenburgh (1982) reported 100 tons of unknown type ore were produced in 1980 from either the Grande 1-7 mine or the nearby Max Dor 1 and 2 mine (locality #92).

Two prospects on the east side of the Colton Hills (localities #91 and #95) are along the trace of a northeast trending shear and intensely altered rock zone up to 400 feet wide. Discontinuous, narrow to 8-foot thick, white to clear veins containing pyrite, limonite, siderite, specularite, and secondary copper minerals occur within the zone. Anomalous gold, silver, lead, and copper content was detected in samples collected by the U.S. Bureau of Mines (Moyle and others, 1986; p. 301).

MRZ-3a $^{(h-3)}$-Clipper Mountains: Several gold prospects, as well as the Gold Hammer mine (locality #101), are along the eastern and northeastern margin of the Clipper Mountains. The workings are along isolated exposures of north, northeast, and east-trending brecciated quartz veins occurring in sheared and intensely altered Precambrian gneiss and schist. Several samples collected from the main vein at the Gold Hammer mine and from a small dump at prospect locality #103 contain anomalous values of gold, copper, lead, zinc, and arsenic (Appendix C, samples 3v, 3v-10, GH-1, 2v, 40-2v and 80-2v). Other mines and prospects are along the continuation of MRZ-3a$^{(h-3)}$ south of the project area.

MRZ-3a $^{(h-4)}$-Granite Mountains: Prospecting for base and precious metal deposits has occurred along the trace of a major low-angle normal fault extending along the northern front of the Granite Mountain as well as on possible related structures along the eastern margin of the range (Plates 1 and 2). Extensive development work was done at the Silver Lode mine in the 1930s but no ore shipments were reported. As indicated by sporadic occurrences of iron staining, quartz veining, and rock alteration along structures encompassed by MRZ-3b$^{(h-1)}$, it is likely that the area contains undiscovered base and precious metal deposits of hydrothermal origin.

AREAS CLASSIFIED FOR DEPOSITS FORMED BY CONTACT METASOMATISM (SKARNS)

Contact metasomatic deposits containing varying amounts of iron, tungsten, tin, copper, lead, zinc, molybdenum, gold, and silver can develop when high-temperature effects and infiltrations of metasomatic fluids and gases from intruding magma cause replacement reactions to occur in surrounding country rock. Although replacement reactions can occur in many different rock types–including sandstone, shale, and volcanic rock–carbonate rocks are by far the most susceptible. Within the project area, metasomatic deposits occur in the northern Providence Mountains along or near contacts between Jurassic granitoid rock and older carbonate rock and quartzite and in the Granite and Clipper mountains they occur in small carbonate roof pendants. Those in the Granite and northern Providence mountains are magnesium-silicate type skarn deposits rich in magnetite and specularite while the known deposits in the Clipper Mountains are enriched in tungsten (scheelite). These areas are shown on Plate 3.

Areas Classified as MRZ-2b$^{(s)}$

Four areas, three in the northern Providence Mountains and one in the Granite Mountains, are classified as containing inferred resources of iron ore formed by contact metasomatic process.

MRZ-2b $^{(s-1)}$-Vulcan Mine Area: MRZ-2b$^{(s-1)}$ encompasses the Vulcan Iron mine and Burro iron prospects, which are on magnesium silicate skarn deposits containing concentrations of magnetite, hematite, limonite, and pyrite. Disseminated magnetite is found in carbonate host rock adjacent to the ore bodies. The main ore body is ovoid and measures about 700 feet by 325 feet. Exploration diamond drilling indicates the deposit extends to a depth of 900 feet (Severy, 1948; p. 5). A smaller ore body to the east upon which the Burro prospect is located measures about 700 feet by 50 to 75 feet. Kaiser Steel produced 2.6 million long tons of blast-furnace-grade ore from the Vulcan mine between 1942 and 1947. The U.S. Bureau of Mines (Moyle and others, 1986) estimate inferred subeconomic resources of 3.0 million long tons of ore containing 50 percent iron remain in the main deposit and inferred subeconomic resources of 315,000 long tons of similar ore are present in the smaller detached ore body located to the east (Burro prospect).

MRZ-2b $^{(s-2)}$-Cornfield Springs Mine Area: MRZ-2b$^{(s-2)}$ encompasses an area containing pods, lenses, and stringers of massive specular hematite. These deposits are exposed intermittently over an area measuring

about 385 feet in length in limestone and quartzite with the lowest outcrop located fewer than 100 feet above the contact with meta igneous rock of unknown age (Moyle and other, 1986). Hewett and others (1936, p. 79) reported the deposit was intersected by mine workings at a depth of 175 feet. Based on limited data, the U.S. Bureau of Mines (Moyle and others, 1986) estimates an inferred subeconomic resource of 110,000 long tons of ore containing 50 to 60 percent iron.

MRZ-2b $^{(s-3)}$-Black Jack Mine Area: MRZ-2b$^{(s-3)}$ encompasses an area containing an exposed lens or pod of specular hematite with minor magnetite. The deposit crops out intermittently over a distance of 300 feet in a northward direction and is 60 feet thick at the largest exposure. The deposit is fault-bound in limestone and shale. The U.S. Bureau of Mines (Moyle and others, 1986) estimates the deposit contains an indicated resource of 230,000 tons of ore averaging 55 to 60 percent iron. The deposit is considered a demonstrated subeconomic iron resource.

MRZ-2b $^{(s-4)}$-Iron Victory Mine Area: MRZ-2b$^{(s-4)}$ encompasses a skarn-bearing marble roof pendant that contains numerous pods and lenses of magnetite and hematite. The diopside- and grosularite-bearing skarn zone measures about 400 feet long by 150 feet wide exposed over a relief of about 120 feet. The U.S. Bureau of Mines (Sabine, 1984) estimates that 110,000 long tons of iron ore averaging about 47 percent iron is present. The deposit was assigned to inferred subeconomic resource category.

Areas Classified MRZ-3a$^{(s)}$

Areas classified MRZ-3a$^{(s)}$ are judged likely to contain undiscovered skarn deposits similar to known deposits in the same producing district or region. Four areas within the project boundaries have been classified MRZ-3a$^{(s)}$.

MRZ-3a $^{(s-1)}$-Providence Mountains: MRZ-3a$^{(s-1)}$ lies along the contact between Paleozoic carbonate strata and Jurassic granitoid rocks in the northern Providence Mountains. The area envelopes three skarn deposits containing magnetite and hematite which have been classified MRZ-2b$^{(s)}$. It also contains numerous small isolated pods and stringers of magnetite and hematite. Additional skarn deposits are likely to exist as indicated by aeromagnetic and ground magnetic surveys (see Geophysical section, Part II).

MRZ-3a $^{(s-2)}$-Colton Hills: MRZ-3a$^{(s-2)}$ encompasses the area containing the B.C. iron prospect (locality #87), the Adams-Ikes iron prospect (#88), and an area marked by a large magnetic anomaly centered in the alluviated valley to the west (see description of anomaly in Geophysical section). The presence of a skarn lens containing pyrite and magnetite at the Adams-Ikes Hope prospect and magnetite veinlets at the B.C. prospect suggest that the anomaly could represent significant skarn-type mineralization at depth.

MRZ-3a $^{(s-3)}$-Granite Mountains: MRZ-3a$^{(s-3)}$ consists of a group of small, isolated marble roof pendants in granitoid terrain (Plates 1 and 3) which, to varying degrees, have been subject to contact metasomatism. Of the four roof pendants assigned to MRZ-3a$^{(s-3)}$, mineral development has occurred only at the Commanche mine (locality #7). A minor amount of iron ore is reported to have been shipped from a small epidote skarn present here (Southern Pacific Company, 1959: T8N, R11 and 12E). Aeromagnetic data does not indicate the presence of any significant iron deposits associated with roof pendants in the Granite Mountains. Chemical analysis of stream sediments draining the east side of the range reveal anomalous concentrations of tungsten and molybdenum (Detra and others, 1985) indicating that economic concentrations of these minerals could be associated with the skarns.

MRZ-3a $^{(s-4)}$-Clipper Mountains Tungsten Mine Area: Two tactite zones occur in limestone near its contact with quartz diorite. One hundred fifty tons of ore yielding 96 units of WO_3 were produced in the early 1950s (Wright and others, 1953). The significance of remaining resources cannot be evaluated from available data.

AREAS CLASSIFIED FOR INDUSTRIAL MINERALS

Industrial minerals that are present or likely to be present in the project area include industrial sand, limestone, dolomite, marble, quartzite, perlite, and zeolites. Areas classified relative to these minerals are presented on Plate 4.

Areas Classified MRZ-2a$^{(i)}$

MRZ-2a $^{(i-1)}$-Industrial Sand: Kelso Dune Field: The mineral resource potential of the Kelso Dunes Wilderness Study was evaluated in detail by Yeend and others (1984) who estimate that 12.8 billion tons of quartz sand and 2.4 billion tons of feldspar are present. Based on 86 samples collected and analyzed in their study, the dune sand also contains an average of 1 to 4 percent magnetite, 0.35 percent ilmenite, and 0.045 ppm gold. Locally, the gold content measures up to 17 ppm. The glass (quartz)- and ceramic (feldspar)-grade sand are considered to be marginal reserves with by-product magnetite and gold

Areas Classified MRZ-3a$^{(i)}$

Five areas have been classified MRZ-3a$^{(i)}$ for industrial minerals. Although no reported production of industrial minerals has occurred within the project boundary, the areas discussed below are judged likely to contain deposits similar to known deposits in the same region. For purposes of discussion, the areas classified are grouped by mineral commodity type.

CARBONATE ROCK

MRZ-3a $^{(i-1)}$-Northern Providence Mountains-Limestone: As shown on Plate 4, portions of the northern Providence Mountains have been classified MRZ-3a for limestone resources. Exposed in this area is up to a 5,000-foot-thick sequence of carbonate rock composed predominantly of limestone of Middle Devonian to Lower Triassic age. From oldest to youngest, the sequence includes the upper part of the Sultan Limestone, the Monte Cristo Formation, the Bird Spring Formation, and the Moenkopi Formation. Although there has been no production from these areas, these formations or similar-age formations have recorded production elsewhere in the Mojave Desert

province and, therefore, may be important resources areas of limestone as shown in Bowen and others (1973).

MRZ-3a $^{(i-2)}$-Northern Providence Mountains-Dolomite: Exposed in this area is a sequence of Lower Cambrian to Middle Devonian carbonate rocks composed predominantly of dolomite. The section measures about 5,000 feet thick and includes the Chambless, Cadiz, Bonanza King, Nopah, and lower Sultan formations. Dolomite has been produced from carbonate rock units of similar ages elsewhere in the southwest and this area may contain similar quality rock.

QUARTZITE

MRZ-3a $^{(i-3)}$-Northern Providence Mountains: The area classified MRZ-3a$^{(i-3)}$ encompasses outcrops of the Prospect Mountain Quartzite. Exposures of the Prospect Mountain Quartzite have been recognized over a large area in southeast California. Ver Planck (1966; p. 29) suggests that the unit is generally impure, but that locally it could contain usable bodies of high purity quartzite. He identifies Prospect Mountain Quartzite exposed in the Toughnut Spring area of the Providence Mountains just north of the project area as one of several localities containing massive sections of vitreous quartzite measuring between 50 and 100 feet thick.

ZEOLITES

MRZ-3a$^{(i-4)}$-Bristol and Old Dad Mountains: The area classified MRZ-3a$^{(i-4)}$ encompasses the northwesterly trending outcrop of tuff, tuff breccia, and associated vitrophyric rock deposits in volcanic terrain of the Bristol Mountains, as well as similar isolated deposits located to the east (Plates 1 and 4). Stinson (1988) collected and analyzed five samples from a 60-foot-thick altered tuff locality near the Ribbon Rock mine and found them to contain the zeolite minerals clinoptilolite, mordenite, and phillipsite. Two of the samples were composed of 50 to 75 percent clinoptilolite. Other similar-looking altered tuff localities were observed elsewhere within the area classified MRZ-3a$^{(i-4)}$.

PERLITE

MRZ-3a $^{(i-4)}$-Bristol / Old Dad Mountains: In addition to zeolitized tuffaceous beds described above, the area classified MRZ-3a$^{(i-4)}$ also encompasses stratigraphically associated vitrophyric volcanic beds. The beds range from a few feet to over 20 feet in thickness, are light-gray to black in color, and normally exhibit prominent flow banding. The rock is characterized by splintery fracture. No well-developed perlitic structure was observed in a field survey of these deposits, but it is possible that good quality perlite deposits are present locally. Several hundred tons of expansible perlite have been mined at the Glassy Rock mine located less than a mile south of the project boundary (Wright and others, 1953; p. 187).

MRZ-3a $^{(i-5)}$-Van Winkle Mountain: The area classified MRZ-3a$^{(i-5)}$ encompasses vitrophyric volcanic beds which both underlie and overlie cliff-forming banded rhyolite flows that are exposed on the northwest and west sides of Van Winkle Mountain. The beds range from 10 to 30 feet thick. The rock is normally dark-gray to black, exhibits prominent flow banding, and typically shows splintery fracture. No well-developed perlitic structure was observed in a field survey of these beds, but good quality perlite could be present locally. No perlite production has occurred on Van Winkle Mountain, although the Harper perlite prospect was located on the northwest flank in the 1950s (Wright and others, 1953; p. 168).

AREAS CLASSIFIED IN WILDERNESS STUDY AREAS

Four federal government wilderness study areas (WSAs) are located in the study area.

As shown on Plates 2, 3, and 4, these are the (1) Providence Mountains WSA (CDCA-263); (2) South Providence Mountains WSA (CDCA-262); (3) the Bristol and Granite Mountains WSA (CDCA-256); and (4) the Kelso Dunes WSA (CDCA-250). Mineral resource evaluation reports prepared by the U.S. Geological Survey and/or the U.S. Bureau of Mines were available for these WSAs and were used as source data in the preparation of this report.

Each of the WSAs includes land which has been classified into the various categories of MRZ-2 and MRZ-3 (Plates 2, 3, and 4). These are as follows:

1. Much of the Kelso Dune field has been classified MRZ-2a for industrial sand resources. These deposits contain quartz and feldspar sand used in the manufacturing of glass, ceramics, and a host of other products. The adjacent Santa Fe Railroad line provides convenient transport facilities.

2. Parts of the Northern Providence Mountains WSA have been classified MRZ-2b and MRZ-3a for base and precious metals of hydrothermal origin and for iron resources of contact metasomatic origin. Also, much of the area includes thick carbonate rock deposits which may represent significant limestone and dolomite resources (MRZ-3a).

3. Much of the South Providence Mountains WSA has been classified MRZ-2b and MRZ-3a for base and precious metal deposits of hydrothermal origin.

4. Part of the Bristol Mountains WSA has been classified MRZ-2b and MRZ-3a for iron resources of contact metasomatic origin and MRZ-3a for base and precious metal resources of hydrothermal origin.

CONCLUSIONS

Mineral deposits of potential economic interest which are present or likely to be present within the area covered by the Kerens, Flynn, and Colton Well 15-minute quadrangles include: precious and base metals of hydrothermal origin; iron, tungsten, and associated metals formed by contact metasomatic processes; and the industrial minerals limestone, dolomite, marble, quartzite, zeolites, industrial sand, and perlite formed by diverse processes. Significant mineral resource areas identified in this study are: (1) the Kelso Dune field, which contains 15 billion tons of marginal industrial sand reserves (MRZ-2a); (2) the east margin of the Providence Mountains along which significant base and metal resources are inferred to exist (MRZ-2b); and (3) isolated areas in the northern Providence Mountains and Granite Mountains which contain demonstrated and inferred, presently subeconomic, resources of iron (MRZ-2b). All of these are located within, or partially within, the four U.S. Bureau of Land Management wilderness study areas in the project area.

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REFERENCES

Bailey, G.E., 1904, Map and register of mines and minerals of San Bernardino County, California [Louisiana Purchase Exposition, 1904] California State Mining Bureau, 20 p.

Bassett, A.M., and Kupfer, D.H., 1964, A geologic reconnaissance in the southeastern Mojave Desert, California: California Division of Mines and Geology Special Report 83, 43 p., scale 1:125,000.

Bishop, C.C., 1963, Geologic map of California - Needles Sheet: California Division of Mines and Geology, scale 1:250,000.

Bowen, O.E., Gray, C.H., Jr., and Evans, J.R., 1973, The mineral economics of the carbonate rocks, *in* Bowen, O.E., ed., Limestone and dolomite resources of California: California Division of Mines and Geology Bulletin 194, 60 p.

California State Mining and Geology Board, 1983, California surface mining and reclamation policies and procedures: California Division of Mines and Geology Special Publication 51, Second Revision; 38 p.

Casey, B.J., 1981, Geology of a portion of the northwestern Bristol Mountains, Mojave Desert, California: Unpublished University of California Riverside M.S. thesis; 128 p., 3 plates, scale 1:24,000.

Clark, C.W., 1921, Lower and Middle Cambrian formations of the Mojave Desert: University of California Department of Geological Sciences Bulletin, v. 13, p. 1-7.

Clark, W.B., 1970, Gold districts of California: California Division of Mines and Geology Bulletin 193, 186 p.

Cloudman, H.C., Huguenin, E., and Merrill, F.J.H., 1919, San Bernardino County, *in* Mines and mineral resources of California (1915-1916): California State Mining Bureau, Report 15 of the State Mineralogist, Part VI, p. 775-699.

Crawford, J.J., 1894, Twelfth Report of the State Mineralogist, California State Mining Bureau, 541 p.

Crawford, J.J., 1896, Thirteenth Report of the State Mineralogist, California State Mining Bureau, 726 p.

Davis, G.A., 1973, Geologic studies of the hypothesized Death Valley fault zone, in Southern California Edison Company, information concerning site characteristics, Vidal Nuclear Generating Station, Vol. 5, Appendix 2.5-E, Attachment A, p. E-A-1 to E-A-17.

DeGroot, H., 1980, San Bernardino County - Its mountain plains and valleys, *in* Tenth Annual Report of the State Mineralogist: California State Mining Bureau, p. 218-539.

Detra, D.E., Meier, A.L., Goldfarb, R.J., and Weaver, S.C., 1984, Analytical results and sample locality map of stream sediment, panned concentrate, and rock samples from the South Providence Mountains Wilderness Study Area, San Bernardino County, California: U.S. Geological Survey Open-File Report 84-116, 26 p.

Detra, D.E., and Kilburn, J.E., 1985, Analytical results and sample locality map of heavy-mineral-concentrate samples from the Bristol/Granite Mountains (CDCA 256) Wilderness Study areas, San Bernardino County, California: U.S. Geological Survey Open-File Report 85-510, 8 p., scale 1:62,500.

Emery, K.O., and Easton, W.H., 1951, Mitchell's Caverns, California: Southern California Academy of Sciences Bulletin 50, p. 3-4.

Eric, J.H., 1948, Tabulation of copper properties in California: California Division of Mines Bulletin 144, Part 3, p. 199-429.

Folger, P.F., Detra, D.E., Goldfarb, R.J., Crock, J.G., Briggs, P.H., and Bradley, L.A., 1986, Analytical results and sample locality map of heavy-mineral-concentrate and rock samples from the Providence Mountains Wilderness Study Area (CDCA-263), San Bernardino County, California: U.S. Geological Survey Open-File Report 86-512; 58 p., 1 plt.

Fuis, G.S., 1981, Crustal structure of the Mojave Desert, California: in Howard, K.A., and others, eds., Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, U.S. Geological Survey Open-File Report 81-503, p. 36-38.

Gay, T.E., Jr., 1957, Iron industries, *in* Wright, L.A., ed., Mineral Commodities of California: California Division of Mines Bulletin 176, p. 245-274.

Glazner, A.F., Nielson, J.E., Howard, K.H., and Miller, D.M., 1986, Correlation of the Peach Springs Tuff, a large-volume Miocene ignimbrite sheet in California and Arizona: Geology, vol. 14, p. 840-843.

Goodwin, J.G., 1957, Lead and zinc in California: California Journal of Mines and Geology, v. 53, nos. 3 & 4, p. 353-758.

Gray, C.H., Jr., and Bowen, O.E., 1980, The limestone and dolomite resources of the Mojave Desert Province, California, *in* Fife, D.L. and Brown, A.R., eds., Geology and Mineral Wealth of the California Desert (Dibblee Volume): Santa Ana, California South Coast Geological Society, p. 150-161.

Hazzard, J.C., 1937, Lower Triassic rocks in San Bernardino County, California [abs]: Geological Society of America Proceedings for 1936, p. 329.

Hazzard, J.C., 1954, Rocks and structure of the northern Providence Mountains, San Bernardino County, California, *in* Jahns, R.H., ed., Geology of Southern California: California Division of Mines Bulletin 170, Chapter 4, p. 27-35.

Hazzard, J.C., and Mason, J.F., 1936, Middle Cambrian formations of the Providence and Marble mountains, California: Geological Society of America Bulletin 47, p. 229-240.

Hewett, D.F., Callaghan, E., Moore, B.N., Nolan, T.B., Rubey, W.W., and Schaller, W.T., 1936, Mineral resources of the region around Boulder Dam: U.S. Geological Survey Bulletin 871, 197 p.

Hodge, E.T., 1935, Available raw materials for the Pacific coast iron industry: Corps of Engineers, U.S. Army, War Department, vol. 3, North Pacific Division; Appendix E-5, p. 10-13.

Howard, K.A., Kilburn, J.E., Simpson, R.W., Fitzgibbon, T.T., Detra, D.E., Raines, G.L., and Sabine, C., *in publication* Mineral resources of part of the Bristol/Granite Mountains Wilderness Study Area, San Bernardino County, California: U.S. Geological Survey Bulletin 1712-C, scale 1:62,500.

Irelan, W., 1888, San Bernardino County: California Mining Bureau Report 8; p. 490-512.

Jones, C.C., 1909, An iron deposit in the California desert region: Engineering and Mining Journal, v. 87, p. 785-788.

Kupfer, D.H. and Bassett, A.M., 1962, Geologic reconnaissance map of part of the southeastern Mojave Desert, California: U.S. Geological Survey Mineral Investigations Field Studies Map MF-205, scale 1:125,000.

Lachenbruch, A.H., and Sass, J.H., 1981, Heat flow and its implication for tectonics and volcanism in the Basin and Range province: in Howard, K.A., and others, eds., Tectonic framework of the Mojave and Sonoran deserts, California and Arizona: U.S. Geological Survey Open-File Report 81-503, p. 56-58.

Larney, C.A., 1948, Vulcan iron-ore deposit, San Bernardino County, California: California Division of Mines Bulletin 129, part F, p. 87-95.

Lorey, F. III, 1985, History of mining, Providence Mountains: California Geology, vol. 38, No. 2; p.p. 27-33.

Lukk, M.E., 1982, The geology and geochemistry of the Tertiary volcanic rocks of the northeastern half of the Clipper Mountains, eastern Mojave Desert, California: Unpublished University of California Riverside M.S. Thesis; 120 p., 3 plates, scale 1:24,000.

Miller, D.M., Howard, K.A., and John, B.E., 1982, Preliminary geology of the Bristol Lake region, Mojave Desert, California, in Cooper, J.D., compiler, Geologic excursions in the California desert: Geological Society of America 78th Annual Mtg., Cordilleran Section, Anaheim, California, April 19-22, 1982, p. 91-100.

Miller, D.M., Glick, L.L., Goldfarb, R., Simpson, R.W., Hoover, D.M., Detra, D., Dohrenwend, J.C., and Munts, S.R., 1985, Mineral resources and resource potential map of the South Providence Mountains Wilderness Study Area, San Bernardino County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1780-A, 29 p., scale 1:62,500.

Moore, L., 1971, Economic evaluation of California-Nevada iron resources and iron ore markets: U.S. Bureau of Mines Information Circular 6511, 207 p.

Moyle, P.R., Olson, J.E., and Gaps, R.S., 1986, Mineral resources of the Providence Mountains Study Area, San Bernardino County, California: U.S. Bureau of Mines Open-File Report MLA 47-66; 306 p., 1PH.

Munts, S.R., 1983, Mineral resources of the Kelso Dunes Wilderness Study Area (BLM No. CDCA-060-250), San Bernardino County, California: U.S. Bureau of Mines Open-File Report MLA 107-83, 16 p.

Munts, S.R., 1984, Mineral resources of the South Providence Wilderness Study Area (BLM NO. CDCA-262), San Bernardino County, California: U.S. Bureau of Mines Open-File Report MLA 32-84, 31 p.

Sabine, C., 1971, Plutonic rocks of the Granite Mountains, eastern San Bernardino County, California: Geological Society of America Abstracts with Program, v. 3, no. 2, p. 189.

Sabine, C., 1984, Mineral investigation of the Bristol/Granite Mountains Wilderness Study Area, San Bernardino County, California: U.S. Bureau of Mines Open-File Report MLA 28-84, 26 p.

Severy, C.L., 1948, Mining methods at the Vulcan Iron Mine, San Bernardino County, California: U.S. Bureau of Mines Information Circular 7437, 11 p.

Sharp, R.P., 1966, Kelso Dunes, Mojave Desert, California: Geological Society of America Bulletin, v. 77, p. 1045-1074.

Sharp, R.P., 1978, The Kelso Dune complex, in Greeley, R., Womar, M.B., Papson, R.P., and Spudis, P.D., eds., Aeolian features of southern California: a comparative planetary geology guidebook: Washington, D.C., NASA Office of Planetary Geology, p. 54-63.

Sharp, R.P., 1982, Kelso Dunes, *in* Cooper, J.D., ed., Geologic excursions in the California desert: Geological Society of America, Cordilleran Section, Guidebook, p. 83-87.

Shaw, J.D., 1961, Black Jack iron ore deposit, San Bernardino County, California: Transworld Resources Corporation, unpublished company report, 10 p.

Southern Pacific Company, 1959, Geology and mineral resources survey, Township 8 North, Ranges 9-10, 11-12, 13-14, 15-16 East, Township 9 North, Ranges 9-10, 11-12, 13-14, 15-16 East; Township 10 North, Ranges 9-10, 11-12, 13-14, 15-16 East; Township 11 North, Ranges 9-10, 11-12, 13-14, 15-16 East; San Bernardino Base and Meridian, San Bernardino County, California: scale 1:24,000.

Southern Pacific Company, 1964, Minerals for Industry, Southern California: Volume II, 242, p., scale 1:250,000.

Stein, B.A., and Warnick, S.F., eds., 1979, Granite Mountains resources survey: University of California Santa Cruz, Environmental Field Program Publication No.1, 361 p.

Stinson, Melvin C., Zeolites in California: California Division of Mines and Geology Bulletin 208.

Stone, P., Howard, K.A., and Hamilton, W., 1983, Correlation of metamorphosed Paleozoic strata of the southeastern Mojave Desert region, California and Arizona: Geological Society of America Bulletin 94, p. 1135-1147.

Thompson, D.F., 1929, The Mojave Desert region; a geographic, geologic, and hydrologic reconnaissance: U.S. Geological Survey Water-Supply Paper 578, 759 p.

Tucker, W.B., 1920, Los Angeles Field Division: California State Mining Bureau, Report 17 of the State Mineralogist, p. 263-390.

Tucker, W.B., 1924, Los Angeles Field Division: California State Mining Bureau, Report 20 of the State Mineralogist, No.1, p. 33-30 and 185-200.

Tucker, W.B., and Sampson, R.J., 1930, Los Angeles Field Division, San Bernardino, County: California Division of Mines, Report 26 of the State Mineralogist, no. 3, p. 202-325.

Tucker, W.B., and Sampson, R.J., 1931, Los Angeles Field Division, San Bernardino County: California Division of Mines, Report 27 of the State Mineralogist, no. 3, p. 262-401.

Tucker, W.B., and Sampson, R.J., 1943, Mineral resources of San Bernardino County: California Journal of Mines and Geology, v. 39, no.4, p. 427-549.

U.S. Bureau of Mines and U.S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U.S. Geological Survey Circular 831, 5 p.

U.S. Geological Survey, 1981, Aeromagnetic map of the Needles 1° x 2° quadrangle, California and Arizona: U.S. Geological Survey Open-File Report 81-85, scale 1:250,000.

Ver Planck, W.E., 1966, Quartzite in California: California Division of Mines and Geology Bulletin 187, 58 p.

Vredenburgh, L., 1982, Geology and mineral resources of the Providence Mountains GEM Resource Area, California: U.S. Bureau of Land Management, Administrative Report, 51 p.

Vredenburgh, L.M., Shumway, G.L., and Hartill, R.D., 1981, Desert fever: an overview of mining in the California Desert: Canoga Park, California Living West Press, 323 p.

Wright, L.A., Stewart, R.M., Gay, T.E., Jr., and Hazenbush, G.C., 1953, Mines and mineral deposits of San Bernardino County, California: California Journal of Mines and Geology, v. 49, nos. 1 and 2, p. 49-259, and tables, p. 1-192.

Yeend, W., Dohrenwend, J.C., Smith, R.S.U., Goldfarb, R., Simpson, R.W., Jr., and Munts, S.R., 1964, Mineral resources and mineral resource potential of the Kelso Dunes Wilderness Study Area (CDCA-250), San Bernardino County, California: U.S. Geological Survey Open-File Report 83-647, 19 p.

APPENDIX A

MINE AND PROSPECT DESCRIPTIONS - KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES

NOTE: 1. References presented in the following pages are listed in REFERENCE section at the end of Part III.

2. Mine and prospect descriptions taken wholly or in part from U.S. Bureau of Mines Wilderness Study Area mineral resources evaluations are indicated by an asterisk. See first reference given for source.

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
1	Hercules lode	10N	9E	23	Base and precious metals	One- to 3 ft. wide quartz vein, oriented N10°W, 60°W developed by 150 ft. deep inclined shaft. No recorded production. Analysis of select sample shows no significant metal content (Sample 149, Appendix C).	Southern Pacific Co., 1964,
2	Kit Fox barite prospect	11N	10E	33	Barite	One- to 6 ft. wide barite vein occupying fault oriented N20°W, 45°S. Development work limited to small open cut and construction of ore bin. Analysis of a select sample shows anomalous copper content (Sample 2Ba-1; Appendix C).	Southern Pacific Co., 1964,
3	Ribbon Rock "Onyx" (banded marble) mine	8N	10E	8	Dimension Stone	Two- to 20 ft. bed of partly silicified banded marble. A small amount of rock was mined prior to 1953 for test purposes. Analyses of two select samples collected from mine area show anomalous arsenic content (Samples OX-1, OX-2; Appendix C).	Southern Pacific Co., 1964, Wright & others, 1953, p. 259
4	*Prospect	9N	11E	25	Base and precious metals	One ft. wide by 100 ft. long quartz vein in granodiorite. Development work consists of 10 ft. by 12 ft. open pit.	Sabine, 1984, p. 25
5	Parker Mill site Kelso Dune Field	9N	12E	9/10	Sand, feldspar, magnetite, gold	Based on evaluation by U.S. Bureau of Mines, eastern two-thirds of Kelso Dune fields has high potential for development of glass and feldspar sand resources with by-product magnetite and gold.	Munts, 1984 Yeend & others, 1984
6	Buena Suerte	9N	9E	21	Base and precious metals	Small open pit prospect.	Stein & Warrick, 1979, p. 39
7	*Commanche mine	9N	12E	26	Iron	Four hundred ft. by 30-60 ft. thick pendant of white marble and epidote skarn developed by 2 adits measuring 60 and 200 ft. long and an open cut. A small amount of ore is said to have been produced.	Sabine, 1984, p. 13-16
8	*Prospect	9N	12E	26	Base and precious metals	104 ft. long adit in diorite. Green malachite coatings observable at portal, but no significant metal values detected from geochemical analyses of three chip samples collected by U.S. Bureau of Mines.	Sabine, 1984, p. 25

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
9	Golden Legend Nos. 1 and 2	9N	13N	31	Base and precious metals	7 ft. thick by 40 ft. long quartz vein in quartz monzonite prospected by open cut. Three samples collected by the U.S. Bureau of Mines showed no significant metal values.	Sabine, 1984, p. 25
10	*Iron Victory prospect	8N	12E	2	Iron	Diopside- and grossularite-bearing skarn zone measuring 400 ft. long by 150 ft. wide that contains lenses and pods of magnetite and hematite. U.S. Bureau of Mines estimates that 110,000 tons of magnetite-hematite are present.	Sabine, 1984, p. 22-24 Wright & others, 1953, p. 259
11	*Silver Lode prospect (Silver Queen, Pine Ridge)	8N	13E	6	Base and precious metals	Disseminated sulfides of iron, copper, lead, and zinc occur sporadically along north-westerly and north-easterly-trending, steeply dipping joint planes in quartz monzonite and granodiorite. The joints are marked by chloritic and sericitic alteration of the wall rock and, locally, quartz veining. Development work consists of 2 adits, 3 shafts, 5 pits, and a trench. No reported production.	Sabine, 1984, p. 17-21
12	*Prospect	8N	13E	18	Base and precious metals	Prospect pit located along east-northeast-trending, 2,000 ft. long zone of en echelon quartz veins in quartz monzonite.	Sabine, 1984, p. 25
13	*Lopez No. 3 prospect	11N	13E	36	Base and precious metals	Variably oriented, iron rich brecciated shear zones in limestone and shale prospected by 2 adits and an inclined shaft. One shear zone trends east northeast and dips 30°- 40°SE. Geochemical analyses of 8 chip samples show anomalous gold, silver, lead, and zinc.	Moyle & others, 1986, p. 291

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
14	*Iris Fin prospect	11N	13E	36	Base and precious metals	One pit. Sample collected by U.S. Bureau of Mines along contact between shale and limestone contained 0.2 oz/ton silver.	Moyle & others, 1986, p. 291
15	*Black Jack mine	11N	13E	36	Iron	The deposit consists of a fault bound north-trending, steeply west-dipping lens or block of specular hematite with minor magnetite in limestone and shale metasediments of Paleozoic age. The deposit crops out for 300 ft. along strike, is 60-80 ft. thick, up to 145 ft. deep and is estimated to contain an indicated sub-economic resource of 230,000 long tons at a grade of 55% to 60% iron. Four chip samples across large outcrops contained 52% to 60% iron. The deposit is developed and explored by one 45 ft. deep shaft, 2 pits, and 6 diamond drill holes. The property is a patented claim.	Moyle & others, 1986, p. 291 Shaw, (1961) Wright & others, 1953, p. 91, 259 Tucker & Sampson, 1943, p. 127, 468
16	*Prospect	11N	13E	36	Base and precious metals	One 12 ft. long adit and one trench located along a 1 ft. thick gouge zone containing chlorite. The zone strikes N60°E and dips 65°SE in shale or phyllite. Two samples collected contained no gold or silver.	Moyle & others, 1986, p. 291
17	*Kelso Placer prospect-north	10N	13E	3	Base and precious metals	Poorly -sorted alluvial fan deposits. Visible gold obtained in the U.S. Bureauof Mines pan sampling (seven 0.38 ft^3 samples). No workings.	Moyle & others, 1986, p. 292

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
18	Rex Mine	10N	13E	9	Base and precious metals	Brecciated, pinch and swell, gold-bearing quartz vein occupies a steeply-dipping fault, trending N25°W. The vein is exposed over a distance of 140 ft., U.S. Bureau of Mines assays of samples containing gold (9 of 19) ranged from 0.016-0.564 oz/ton. The brecciated fault zone averages 5 ft. in thickness and is marked by bands of orange, red, purple, and brown colored gauge owing to abundant specular and earthy hematite content. Country rock is quartz diorite. Reported production amounts to 26 tons of crude ore yielding 12 oz. of gold mined in 1939 and 100 tons of crude ore yielding 5 oz. of gold in 1951. Small shipments are reported for 1934, 1948, and 1952.	Moyle & others, 1986, p. 193-198, 292 Wright & others, 1953, p. 259
19	*Lone Tree prospect	10N	13E	11	Base and precious metals	Adit with 16 ft. of drift and 13 ft. of crosscut is located along 2 shear zones, each measuring about 3 ft. thick and oriented N25°W, 70°NE, and N63°E, 49°SE, intersect in buff, medium-grained, meta-igneous rock. The northeast zone contains some quartz and the northwest zone contains minor malachite. No gold and silver detected.	Moyle & others, 1986, p. 292

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
20	*Cornfield Springs Consolidated mine	10N	13E	11	Iron	A patented claim containing pods, lenses, and stringers of massive specular hematite replace quartzite and limestone metasediments of lower Paleozoic age less than 100 ft. above a contact with meta-igneous rocks of unknown age. The replacement bodies are generally concordant with bedding which strikes N65°E and dips 35°SE. The iron deposit crops out discontinuously for almost 400 ft., is up to 20 ft. thick (up to 230 ft. thick at depth). U.S. Bureau of Mines calculates 11,000 long tons of inferred subeconomic resources grading at least 50% iron. Several hundred thousand tons of additional ore may be present. The deposit was developed by 2 inclined shafts, 2 inclined adits, and 3 pits.	Moyle & others, 1986, p. 189-182, 292 Wright & others, 1953, p. 65, 259 Hewett & others, 1936, p. 79 Hodge, 1935, p. 10 Jones, 1909, p. 788
21	*Kelso placer prospect-south	10N	13E	15	Placer Gold	Poorly sorted fluvial deposits. Visible gold observed in 3 of 4 samples panned by the U.S. Bureau of Mines.	Moyle & others, 1986, p. 293
22	*Bonanza 1-8 placer prospect	10N	13E	21	Placer Gold	Poorly sorted fluvial deposits. Two of 5 samples panned by the U.S. Bureau of Mines contained visible gold.	Moyle & others, 1986, p. 293
23	*Iron Mountain prospect	10N	13E	23	Iron	Two adits, 10 ft.- and 37 ft. long, are located along northeast-trending, brecciated shear zones in interbedded shale and limestone. A skarn-type mineral assem-blage consists of magnetite, specular hematite, garnet, epidote, pyrite, chalcopyrite, secondary copper minerals, znc quartz. The zones are localized, partially controlled by bedding, and occur very low in the Paleozoic assemblage, close to Jurassic intrusive rocks. No gold, silver, lead, or zinc detected in 4 chip and select samples.	Moyle others, 1986, p. 293

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
24	*Prospect	10N	13E	24	Base and precious metals	Prospect workings consisting of 1 adit, at least 150 ft. long, and 3 pits are located along a north-northeast-trending fault contact between limestone and rhyolite. The sheared to brecciated rocks are iron-oxide stained and contain malachite and chrysocolla. Anomalous amounts of gold and silver were detected in sampling conducted by the U.S. Bureau of Mines.	Moyle others, 1986, p. 293
25	*Rector Not prospect	10N	14E	30	Base and precious metals	One adit 30 ft. long and 2 open cuts, 100 ft. long are located along a fault which strikes N30°W and dips 55°NE in lime-stone near a contact between silicified malachite, chalcopyrite, and galena bearing limestone and iron oxide stained rhyolite. Analyses of two selected samples by the U.S. Bureau of Mines show anomalous values of gold, silver, lead, and zinc.	Moyle & others, 1986, p. 294
26	Vulcan mine	10N	13E	25	Iron	700 ft. long by 325 ft. wide magnesium silicate skarn deposit occurs along a northwest-trending fault contact separating limestone and dolomite and quartz monzonite. Ore consists mainly of magnetite, lesser amounts of specular and earthy hematite, with minor limonite and pyrite. About 2.6 million long tons of 50% iron were produced by Kaiser Steel between 1942 and 1947.	Moyle & others, 1986, p. 199-202, 294 Gay, 1957, p. 245-274 Wright & others, 1953, p. 100, 259 Lamey, 1948, p. 87-95 Severy, 1948
27	*Burro prospect	10N	13E	25	Iron	Possible eastward extension of the Vulcan deposit. The ore body is estimated to consist of 315,000 long tons by the U.S. Bureau of Mines.	Moyle & others, 1986, p. 199-202, 294 Lamey, 1954, p. 94

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
28	*Copper King-Queen of the Night prospect	10N	14E	30	Base and precious metals	One shaft 20 ft. deep, 1 adit 6 ft. long, and 3 bulldozer cuts, each about 100 ft. long, are located along a fault zone approximately 4 ft. thick, which strikes N5°-20°W and dips 65°NE in light-gray, iron-oxide stained limestone. The 80 ft. long exposure is subparallel with and less than 100 ft. from a contact with rhyolite. The fault zone is probably several hundred ft long. The limestone is silicified and contains blebs of malachite and azurite and veinlets of calcite. Microprobe examination showed fine-grained inclusions of cinnabar and iodyrite (AgI) in the malachite. Two chip samples contained no detectable gold or silver.	Moyle others, 1986, p. 294
29	*Tip Top prosect	10N	14E	29/30	Base and precious metals	Three shafts, 20 ft. to 70 ft. deep, and 2 adits 8 ft. and 10 ft. long, are located along 1.0-3.5 ft. thick fault zones which strike N45°W, N10°E and dip 80°NE-85°NW in fractured, gray, iron-oxide stained limestone south of a rhyolite contact. Rocks contain minor to abundant malachite with chalcopyrite and possible bornite. High values of copper and anomalous values of silver were detected in sampling conducted by the U.S. Bureau of Mines.	Moyle others, 1986, p. 294

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
30	*Burro No. 31 prospect	10N	14E	29	Base and precious metals	Two adits (68 ft. and 250 ft. long) and 1 pit are located along northwest-trending, vertical to northeast dipping fault zones (1-7 ft.) thick in limestone. Two short fault zones are silicified and contain quartz, calcite, iron and manganese oxides, malachite, possibly smithsonite, minor magnetite, and chalcopyrite. A 20 ft. wide, prominent, fault-bound zone is internally sheared, faulted, bleached, and has localized silicification and iron-oxide staining. Fault-bound talcose zones are also contained in the main fault zone. Trace gold and anomalous silver, copper, lead, and zinc were detected in U.S. Bureau of Mines sampling survey.	Moyle others, 1986, p. 295
31	*East Burro prospect	10N	14E	29	Base and precious metals	Eight bulldozer cuts, each about 50 ft. in length explore irregular northeast-trending contact zone between silicified rhyolite on the north and a weathered, granitic intrusion on the south. The zone is intensely bleached, contains fragments of limestone, and exhibits chloritic alteration. The remainder of workings are in weathered, friable to sheared granitic rock without apparent structure. Anomalous values of copper and silver were detected in U.S. Bureau of Mines sampling survey.	Moyle & others, 1986, p. 295
32	*Burro 54 and 55 prospect	10N	14E	28	Base and precious metals	110 ft. long bulldozer cut within a deeply weathered, intensely iron-oxide altered granitic intrusion lies near a contact with a rhyolite intrusion. One grab sample contained 0.0022% copper; no gold or silver detected.	Moyle & others, 1986, p. 296 Wright & others, 1953, p. 259 Tucker, 1921, p. 364-365

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
33	*Sunrise prospect	10N	14E	32	Base and precious metals	One adit 60 ft. long, 1-caved adit, approximately 30 ft. long, and 1 shaft of unknown depth are located along 2-3 ft. thick shear zones in limestone. One zone strikes north, dips 78°E, and contains quartz and carbonate veining with minor iron-oxide, magnetite, and traces of malachite and chalcopyrite. Another fault trends northwest, dips steeply southwest, and contains iron and manganese-oxides in fractures, and minor encrusted malachite. Anomalous values of gold, silver, and copper were detected in U.S. Bureau of Mines sampling survey.	Moyle & others, 1986, p. 295
34	*Prospect	10N	14E	32	Base and precious metals	Two bulldozer cuts of 100 ft. length each, and 1 pit explored north to northwest-trending, southwest dipping shear zones 4-70 ft. thick in and near a contact zone between Paleozoic carbonates and a Jurassic granitic intrusion. One zone contained a 1° ft. thick magnetite vein.	Moyle & others, 1986, p. 295
35	*Silver King mine	11N	14E	33	Silver-lead	Mineralized pods and lenses occur in quartz/calcite cemented breccia along north-trending East Providence fault and associated west-trending cross faults. Main economic metals are silver and lead. Minerals include argentite, argentiferous galena, cerussite, silver chlorides and bromides, malachite, anglesite, and willemite. The ore bodies have been developed and explored by 4 shafts, 7 adits, 11 trenches, and 14 pits. Tucker (1920) estimated $250,000 production in 1880's. From 1918-1920, mine production (U.S. Bureau of Mines statistical files) was 20 tons containing 6.98 oz. gold, 1,489 oz. silver, 11 lb. copper, and 232 lb. lead.	Moyle & others, 1986, p. 298

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
36	*Silver Queen-Golden Horse placer prospects	11N	14E	33	Placer Gold	Claims located in wash containing course sand and gravel of gneissic composition. One pan sample from the active channel contained 3 gold particles with a total weight of 0.008 mg.	Moyle & others, 1986, p. 298
37	*Bonanza King	10N	14E	3	Silver-lead	The deposit occurs as 4-20 ft. thick replacement bodies in brecciated carbonate rocks along en echelon cross-breaks (tension fractures) between the north- northeast-trending, east dipping or vertical boundary fault on the west. The bounding faults diverge with depth; having a 100 ft. span at the surface and a 500 ft., span on the 5th level of the main working. Mineralized zones are recognized by calcite and red iron-oxide in fractures and contain one or more of the following: argentite, cerargyrite, bromyrite, galena, cerussite, sphalerite, smithsonite, malachite, and pyrite. Workings consist of one large multilevel development, 1 tunnel, 7 adits, 6 trenches, and 7 pits. The large working consists of an 800 ft. deep shaft (500 ft. vertical and 300 ft. inclined) with 8 levels. The overall main working is developed by about 20,000 ft. of drifts crosscuts, stopes, and manways. Production from 1883-1887 was valued at $1.8 million, primarily from silver. More than 5,300 tons produced from 1901-1960 contained 56.57 oz. gold, 82,272 oz. silver, 913 lb. copper, 69,275 lb. lead, and 2,312 lb. zinc (U.S. Bureau of Mines statistical files).	Moyle & others, 1986, p. 220-246, 299 Vredenburgh, 1982, p. 9 Wright & others, 1953, p. 72-73, 259 Eric, 1948, p. 300 Tucker & others, 1943, p. 475 Tucker & others, 1931, p. 342 Tucker & others, 1930, p. 270 Tucker, 1924, p. 198 Tucker, 1921, p. 360-361 Cloudman & others, 1919, p. 827 Mining World, Feb. 6, 1906, p. 225-226 Crawford, 1896, p. 330, 606 Crawford, 1894, p. 376 DeGroot, 1890, p. 532 Ireland, 1888, p. 500

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
38	*C and K mine (Bell Gilroy)	10N	14E	16	Silver-lead	400 to 600 ft. wide silicified breccia zone, striking north and dipping 30°-40°E in Paleozoic limestone, contains argentiferous galena. Principle ore bodies are developed at intersections of north- and east striking fracture. Ore is reported to average 20 oz. of silver and 6°-12° lead content. The mine was worked intermittently between 1880's and 1950's and has produced only a small tonnage of ore. Mine workings consist of 4 adits ranging in length from 65-300 ft. Some stoping has been done in 2 of the adits.	Vredenburgh, 1982, p. 43 Wright & others, 1953, p. 103, 259 Eric, 1948, p. 299 Tucker & others, 1943, p. 475 Tucker & others, 1931, p. 341 Tucker, 1930, p. 268-269 Tucker & others, 1921, p. 360 DeGroot, 1890, p. 532
39	Prospect	10N	14E	22	Base and precious metals	----------	----------
40	Mitchell prospect (Mexican mine)	10N	14E	22	Silver-lead	Eight claims in vicinity of Mitchells Caverns. Silver-lead ore has developed along northerly trending, steeply dipping fissures in Paleozoic limestone. No reported production from several bulldozer cuts and 250 ft. adit.	Wright & others, 1953, p. 110
41	*Due Group placer prospect	10N	14E	33	Placer Gold	Placer claim on alluvial fan. Workings consist of 1 pit.	Miller & others, 1985, p. 18 Munts, 1984, p. 20
42	Foshay Barite	10N	14E	32?	Barite	Location of deposit vaguely described by Tucker (1921) as being in Foshay Pass, 26 miles southeast of Kelso. Deposit was not located by Munts (1984), Vredenburgh (1982), or during the course of this study.	Miller & others, 1985, p. 20 Munts, 1984, p. 21 Vredenburgh, 1982, p. 21 Wright & others, 1953, p. 259 Tucker, 1921, p. 334

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
43	*Goldstone Group	10N	14E	31	Base and precious metals	A bulldozer cut, 3 pits, a deep shaft of 25 ft. and 35 ft., a caved inclined shaft, and 2 caved adits are located along veins of milky to colorless quartz, measuring 2-8 in. thick, in syenite and quartz monzonite. Bleaching due to argillic alteration is common near veins. Smaller quartz veinlets parallel main veins on either side. Veins contain various amounts of pyrite, chalcopyrite, specularite, malachite, azurite, and limonite. Host rocks are cut locally by north-trending shear zones, as wide as 3 in., and by epidote and chlorite veinlets. Silicification is common. Anomalous gold, silver, copper, zinc, and lead values detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 20 Munts, 1984, p. 21
44	*Adams-Anna	9N	14E	3	Base and precious metals	Six shafts up to 100 ft. deep, a 75 ft. long adit and 6 trenches have been developed along westerly-trending, vertical-dipping quartz veins measuring up to 1.5 ft. thick. The veins cut orange, bleached, and silicified limestone and quartz monzonite dikes. Vein quartz is colorless to white and contains trace of pyrite, limonite after pyrite, and chrysocolla. Both rock types are cut by pre- and post-mineralization faults, fractures, shears, and breccia zones. Anomalous values of gold, silver, copper, lead, and zinc were detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 20 Munts, 1984, p. 21

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
45	*Blue Danube	9N	13E	2	Placer Gold	A 155 ft. long adit in granite. Granite with chlorite and clay alteration contains three orange clay gouge zones and a breccia zone 6 in. to 1 ft. thick. Exposed in the adit 105 ft. from portal. Breccia zone strikes N31°W and dips 85°W. Trace gold and silver detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 29 Munts, 1984, p. 30
50	*Texas prospect	9N	13E	1	Base and precious metals	A 150 ft. long adit developed along colorless and milky quartz veins with traces of pyrite and marcasite in andesite and rhyolite. The andesite is also cut by a north-trending 6 in. to 5 ft. thick shear zone, and a 6-10 ft. thick rhyolite dike. The andesite is locally bleached and silicified but generally choritic and altered to clay; dike is pale orange, bleached, and silicified. Some limonite is present. A second north-trending shear zone, which cuts the andesite and rhyolite, is 2-4 ft. thick and generally parallels west side of dike. Trace gold and anomalous lead, zinc, and molybdenum values detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 29 Munts, 1984, p. 30
51	*Iron King	9N	13E	11	Iron	200 ft. long bulldozer cut, a 4 ft. deep pit, and a 55 ft. long adit are developed along a 10-20 ft. wide zone of magnetite rich, sheared syenite and a 2-6 ft. thick magnetite vein trending N30°E which cut a medium-gray mafic rich syenite. Syenite is locally silicified, is altered to clay, epidote, and chlorite, and is intruded by a 4 ft. thick quartz monzonite dike. Pit exposes a zone of silicified quartz monzonite. Limonite occurs on fractures.	Miller & others, 1985, p. 28 Munts, 1984, p. 29

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
52	*Green Beauty placer	9N	13E	15	Placer gold	Gravel bars 1 in. to 6 ft. wide and 25 ft. long in active arroyo. No workings. One 4 in. by 4 ft. long vertical channel sample of bar gravel; contained 0.2 cents/yd^3 at $400/oz.	Miller & others, 1985, p. 18 Munts, 1984, p. 20
53	*Philadelphia Fluorspar (Providence Mountain mine)	9N	13E	14/23	Fluorite	Quartz monzonite, locally silicified, bleached and sericitized, is cut by a 12-14 in. thick vein of green and purple fluorite which strikes N33°E and dips 75°NW. Vein is brecciated on east side. One 8 ft. deep shaft and 500 ft. of bulldozer cuts on 4 levels. The property may have fluorspar resources. Five chip samples contained 23%-30% fluorine. All samples contained low lead, zinc, and copper values.	Miller & others, 1985, p. 26 Munts, 1984, p. 27 Wright & others, 1953, p. 259
54	*Laurie	9N	13E	13	Base and precious metals	Quartz veins in syenite. Veins trend N12°W, dip 70°-80°W, are as thick as 4 in, are fractured, and contain traces of pyrite. Syenite is cut by numerous fractures and northerly-trending faults, is silicified and bleached within 10-50 ft. of veins, and contains traces of sericite and limonite. Workings consist of 5 trenches, 3 pits, and 3 shafts 20 ft., 30 ft., and 35 ft. deep. Some samples collected by U.S. Bureau of Mines contained anomalous gold, silver, and copper.	Miller & others, 1985, p. 28 Munts, 1984, p. 29
55	*Hayman	9N	14E	18	Base and precious metals	Quartz vein in syenite near the east side of a N20°E trending dacite dike. The vein averages about 1 ft. thick. Smaller (1-3 in. thick) parallel veins occur nearby. Dacite is clay altered and locally silicified. Syenite is silicified and contains specularite in places near the dike. Explored by 1 pit. No significant values detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 22 Munts, 1984, p. 23

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
56	*Sunview	9N	13E	22	Base and precious metals	A 50 ft. long cut in apparently unaltered granite. No significant values detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 27 Munts, 1984, p. 28
57	*Virginia Group	9N	13E	22	Placer Gold	Sandy wash; no workings. No detectable gold from U.S. Bureau of Mines pan sample.	Miller & others, 1985, p. 18 Munts, 1984, p. 20
58	*Edith Group	9N	13E	27/28	Placer Gold	Sandy wash; no workings. No detectable gold from U.S. Bureu of Mines pan sample.	Miller & others, 1985, p. 18 Munts, 1984, p. 20
59	*Midnight Group	9N	13E	25/26	Base and precious metals	Quartz monzonite cut by diorite and lamprophyre dikes; locally silicified and limonitic. Exlpored by one prospect pit. Anomalous value of molybdenum detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 27 Munts, 1984, p. 28
60	*Echo	9N	14E	19	Base and precious metals	Quartz, epidote, and magnetite veinless cut syenite, and andesite, quartz monzonite, and diorite dikes. Colorless and milky quartz veinlets are as thick as 3 in. and trend N10°E. Syenite is unaltered; quartz monzonite and andesite are ailicified. Diorite has chlorite, tourmaline, epidote, and clay alteration. A limonitic fracture zone, 12 ft. thick, strikes N48°E and dips 80°E. Workings consist of 2 pits, a 70 ft. long trench, and one 50 ft. deep shaft. Anomalous values of gold detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 23 Munts, 1984, p. 24

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
61	*Sample prospect	9N	14E	9	Base and precious metals	North to northeast-trending, steeply dipping shear zones as thick as 24 in., cut quartz monzonite and 2 west-trending syenite dikes. Both rock types show slight argillic alteration, are locally bleached and silicified, have limonite on fractures, and some iron-oxide stain. In quartz monzonite, blotches of chlorite are locally replaced by pyrite, chalcopyrite, or malachite. Specularite is also presnet on some fractures. Malachite-stained clay gouge zones are as thick as 1.5 ft. with inclusions. Workings consist of 2 small pits and an 86 ft. long adit. Anomalous gold and copper values detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 20 Munts, 1984, p. 21
62	*Prospect	9N	14E	9	Base and precious metals	Quartz veins and multiple shears cut mixed andesite and quartz monzonite. Veins of colorless quartz trend N°30W-N20°E and dips 30°-70°E. White quartz veins trend east and dip steeply north and south. Both vein types show comb structure. Minor amounts of malchite, azurite, chrysocolla, limonite and manganese oxides occur in clear quartz veins. Shear and gouge zones are 1-14 in. thick, trend N10°-75°E, and dip 65°-85°SE. Host rocks are bleached and silicified near veins and have a selvage of clay alteration. Some limonite and iron-oxide stain occurs locally. Workings consist of 3 cuts, 1-caved adit, a 20 ft. long and a 50 ft. long adit. Anomalous gold, silver, lead, and zinc, values detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 21 Munts, 1984, p. 22

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
63	*Warm Springs	9N	14E	17	Base and precious metals	Veins trending N30°-55°E and dipping 70°-90°E and W and northeast-trending shears as thick as 6 in. cut weathered syenite. Veins contain white to colorless quartz, are as much as 16 in. thick, display comb structure locally, and contain pyrite, chalcopyrite, malachite, azurite, limonite, and specularite. Chlorite occurs as discrete veinlets adjacent to quartz veins generally along the footwall contact, or as a cavity filling in quartz vein comb structure. Syenite is altered to clay and in places bleached and silicified near veins. Some sericite and iron oxide stain and limonite are also present. Workings consist of 2 cuts, a 30 ft. deep decline, and a 200 ft. long northwest-trending adit. Anomalous values of gold, silver, and copper detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 21 Munts, 1984, p. 22
64	*Pilot mine	9N	14E	16/17	Base and precious metals	Colorless to white quartz vein, as thick as 6 in., intrudes quartz monzonite. The vein is lenticular and grades into a narrow (1-3 in.) gouge zone on both ends beyond the mine workings. The vein strikes N10°E and dips vertically. Quartz monzonite is bleached, contains limonite, and is altered to clay, quartz, and sericite. Mine workings consist of one 45 ft. deep shaft. Reported production from 1911-1935 is 105 tons of ore containing 86.97 oz. gold, 840 oz. silver, 2,199 lb. lead, and 19,667 lb. copper. Mine may have additional vein-type gold, silver, lead, copper resources.	Miller & others, 1985, p. 22 Munts, 1984, p. 23 Wright & others, 1953, p. 259 Eric, 1948, p. 314 Cloudman & others, 1919, p. 828

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
65	*Providence mine	9N	14E	16	Base and precious metals	North-trending 4 in. thick shear and gouge zone offset by a 6 in. west-trending milky quartz vein is exposed at the collar of a shaft. Veins are lenticular. Host rock is orange, iron stained syenite with feldspars altered to clay. Mine workings consist of 3 shafts; a two-compartment shaft is reported to be 150 ft. deep. Reported production in 1918 was 12 tons of ore containing 455 oz. of silver, 2,456 lb. of lead, and 166 lb. of copper. The mine may have additional lead-silver resources.	Miller & others, 1985, p. 21 Munts, 1984, p. 22 Wright & others, 1953, p. 259 Cloudman & others, 1919, p. 827
66	*Midas Touch	9N	14E	20	Base and precious metals	Veins as thick as 14 in. of colorless and milky quartz-cut biotite quartz monzonite and often parallel dikes. Colorless quartz veins contain pyrite, arsenopyrite, marcasite, disseminated specularite, malachite, chrysocolla, limonite after pyrite, and a trace of selenite. Some quartz veins are blue-black and brecciated, with transparent blue and white quartz cement. Calcite veins also are present. The biotite quartz monzonite is intruded by northwest and northeast-trending quartz monzonite and andesite dikes, is propylitically altered, and is locally bleached and iron-oxide stained; no limonite present. Mine workings consist of 11 pits, 7 shafts as much as 100 ft. deep, and one 25 ft. long decline. Samples collected by the U.S. Bureau of Mines contained anomalous values of gold and trace silver.	Miller & others, 1985, p. 22 Munts, 1984, p. 23
67	Prospect	9N	14E	21	----------	----------	----------

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
68	*Prospect	9N	14E	21	Base and precious metals	Pegmatite, mafic dikes, colorless quartz, and epidote veinlets intrude quartz monzonite and biotite quartz monzonite. Host rock contains a trace of pyrite, minor melachite, and chrysocolla. Workings consist of 2 pits, one 6 ft. long and one 15 ft. deep shaft. No significant cut, metal content detected in samples collected by U.S. Bureau of Mines.	Miller & others, 1985, p. 22 Munts, 1984, p. 23
69	*Buena Vista mine	9N	14E	20/29	Base and precious metals	A quartz vein occurs along the footwall of a fault-controlled, silicified andesite dike in syenite. The vein is 6 in. to 6 ft. thick, colorless to white, and is either massive or a multitude of veinlets. Limonite and local areas of ableached host rock are associated with the vein. It trends N26°E, dips 56°W and is paralled on the footwall by a shear and breccia zone 6 in. thick. Pyrite, chalcopyrite, and malachite occur in trace amounts in the vein; fluorite occurs both in the vein and nearby host rock. The syenite, with intense silicification, has clay alteration and some sericite near dike and vein. Mine workings consist of 1 pit, a caved decline, a partially-caved, 150 ft. deep shaft with at least 2 caved level, and a caved adit. Recorded pre-1940 production fo 6,000 lb. of lead. Anomalous values of gold, zinc, and copper detected in U.S. Bureau of Mines sampling survey.	Miller & others, 1985, p. 23 Munts, 1984, p. 24

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
70	*Valcerie Group	9N	14E	29	Placer Gold	Fluvial sand and gravel deposits in channel ranging from 5 ft.-50 ft. wide and 4-11 ft. deep. No workings. Four samples from a 4 in. by 4 in. channel 45 in. deep from surface to 3 in. into bedrock; contained no detectable gold.	Miller & others, 1985, p. 18 Munts, 1984, p.20
71	*Big Horn mine (Includes Mabel and Contention mines)				Base and precious metals	Colorless to white quartz veins as thick as 4 ft. cut andesite and quartz monzonite dikes and syenite. The veins trend N37°W to 85°E, dip steeply west and east and contain pyrite, chalcopyrite, specularite, and hematite. Some veins are brecciated and cemented with chlorite; shear and (or) gouge zones parallel some veins. Veins and veinlets of specularite and purple and green fluorite occur locally. In places, the syenite is silicified, bleached, and altered to clay and sericite. The andsite dike is cut by a syenite dike and both are cut by colorless quartz veinlets. Mine workings consists of one 15 ft. long cut, 5 pits, 6 shafts as deep as 200 ft. with 2 levels each, and 2 adits 120 ft. and 60 ft. long. Recorded production from 1918-1941 is 844 tons of ore which contained 4,844 oz. gold, 59 oz. silver, 10,684 lb. lead, and 56 lbs. copper.	Miller & others, 1985, p. 23 Munts, 1984, p. 24 Wright & others, 1953, p. 259-Gold Tucker & Sampson, 1943, p. 441-442

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
71 (cont)	*Big Horn mine (Includes Mabel and Contention mines)					Tucker (1920, unpublished field report) indicated 6,000 tons of dump rock assaying $5/ton at $20.67/oz. gold, and about 195,000 tons of reserves in place contained approximately 0.25 oz/ton gold and 1.5 percent copper. Under 1982 economic conditions, these are marginal reserves. The property may have additional vein type gold, silver, lead, copper resources.	
72	*Prospect	9N	14E	29	Placer Gold	Five ft. by 6 ft. by 4 ft. deep pit dug in bottms of Arroyo channel 300 ft. east of the main Big Horn shaft. Syenite bedrock is exposed in the pit floor. Four samples from a 4 in. by 4 in. channel 32 in. long cut in pit face from surface into bedrock. Upper 2 samples (20 in. total length) contained no gold. Two in. layer of gravel immediately above bedrock contained 58 cents/yd^3 at $400/oz. gold. First 10 in. of decomposed bedrock contained 54 cents/yd^3.	Miller & others, 1985, p. 18 Munts, 1984, p. 20
73	*Santa Ana	9N	14E	30	Base and precious metals	22 in. thick milky quarz vein, composed of multiple veinlets separated by clay seams, parallels an adesite dike in syenite. Both andesite and syenite are clay-altered and contain a trace of pyrite and malachite in quartz. Vein explored by one 7 ft. deep decline. No significant metal values detected in one chip sample collected from mine site.	Miller & others, 1985, p. 24 Munts, 1984, p. 25

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
74	*Wild Ass	9N	14E	30	Base and precious metals	Quartz veins cut quartz monzonite and syenite. Veins are 4 in. to 12 in. thick, trend N10° to 20°E, dip 70° to 90°W, and are colorless to white quartz with limonite fracture coatings and a trace of pyrite. The quartz monzonite and syenite contain clay, epidote, and chlorite alteration. There is local silicification in host rock near quartz veins. Workings consist of one 15 ft. deep shaft and a 48 ft. deep decline. Samples collected by U.S. Bureau of Mines contained anomalous values of gold, lead, zinc, and molybdenum.	Miller & others, 1985, p. 24 Munts, 1984, p. 25
75	*Lady Luck	9N	14E	30	Base and precious metals	Quartz veins and quartz monzonite dikes cut syenite and andesite host rock. Fractured veins as thick as 3 ft. of massive white quartz strike N10° to 20°E, dip 20° to 50°N, and contain minor limonite and specularite. Host rock is generally clay-altered, silicified and contains sericite, especially near veins, and limonite on some fractures. Surface workings consist of 6 pits. Rock samples collected by U.S. Bureau of Mines contained anomalous values of gold, lead, zinc, copper, and molybdenum.	Miller & others, 1985, p. 24 Munts, 1984, p. 25

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
76	*Prospect	9N	14E	31	Base and precious metals	Three to 7 ft. thick fault-controlled quartz vein is in syenite and quartz monzonite. The vein strikes north, dips 45° to 65°W, and is traceable for about 800 ft. It is composed of white quartz cut by colorless quartz veinlets; minor colorless quartz veins cut across the main vein and hsot rock at N58°E, and dip 26°W. The host rock is intensely fractured locally, displays pre- and post-vein faults, contains sericite, traces of limonite, and some pink feldspar veinlets, is silicified near the vein, and contains clay alteration. Surface workings consist of 5 pits scattered for about 800 ft. along vein. Anomalous values of gold, lead, zinc, copper, and molybdenum were detected in samples collected by the U.S. Bureau of Mines.	Miller & others, 1985, p. 24 Munts, 1984, p. 25
77	*Golden Gift mine	9N	14E	31	Base and precious metals	A bifurcating vein of semi-translucent quartz with pyrite cuts andesite and syenite. Vein is as thick as 1 ft., strikes N20°E, and dips 37°NW. Parallel calcite veins cut syenite. The host rock is moderately fractured and bleached and contains clay alteration. Workings consist of one 35 ft. deep decline. Recorded production in 1935 was 16.5 oz. gold and 20 oz. silver from 24 tons of ore. Trace gold and silver detected in samples collected by U.S. Bureau of Mines.	Miller & others, 1985, p. 25 Munts, 1984, p. 26

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
78	*Prospect	9N	14E	31	Base and precious metals	Twenty-five ft. thick silicified zone at andesite-quartz monzonite contact. This zone is composed of silicified andesite cut by colorless and milky quartz veinlets which contain pyrite. The andesite is cut by quartz monzonite dikes. Both are cut by subsequent fault and shear zones, some of which are silicified and bleached. Andesite has clay alteration with local admixtures of sericite and quartz. Quartz monzonite has weak clay alteration and is weakly bleached. The silicified zone is explored by 1 pit and a 65 ft. long aidt. Trace gold and silver and anomalous lead, zinc, copper, and molybdenum detected in 8 samples collected from prospect site by U.S. Bureau of Mines.	Miller & others, 1985, p. 25 Munts, 1984, p. 26
79	*Wild Cat	9N	14E	31	Base and precious metals	Colorless quartz, black chalcedony, barite, and magnetite veins cut syenite. The largest quartz vein is 1 ft. thick, brecciated, cemented by limonite, strikes N20°E, and dips 70°W. Fractures in syenite contain traces of malachite, limonite, and manganese oxides. Syenite is intruded by a quartz monzonite dike which has clay and silicic alteration. The vein is explored by 4 pits. Trace gold and silver and anomalous copper were detected in 4 samples collected by U.S. Bureau of Mines.	Miller & others, 1985, p. 25 Munts, 1984, p. 26

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
80	*Golden Cross	9N	13E	36	Base and precious metals	Small quartz veinlets averaging one per ft. cut medium-grained, fractured quartz monzonite. The quartz monzonite is locally altered to clay, and contains trace iron oxides in fractures. Explored by one pit. No significant metal values detected in sample collected by U.S. Bureau of Mines.	Miller & others, 1985, p. 27 Munts, 1984, p. 28
81	*Long Chance	9N	14E	31	Base and precious metals	A 1 ft. thick quartz vein is centered in a 15 ft. thick clay-rich zone in andesite. The vein is colorless quartz, with a few milky quartz breccia fragments, and is cut by milky quartz veinlets. The vein contains a trace of fluorite. Andesite is silicified and chlorite on fractures. Surface workings consist of 1 pit and 2 bulldozer cuts, each 45 ft. long. Anomalous gold value detected in 2 samples collected by U.S. Bureau of Mines.	Miller & others, 1985, p. 25 Munts, 1984, p. 26
82	*Copper Charlie	8N	14E	5	Placer Gold	Arroyo channel, no workings. One pan sample contained 0.8 cents/yd^3 at $400/oz. gold.	Miller & others, 1985, p. 18 Munts, 1984, p. 20

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
83	*Golden Nugget	8N	14E	6	Base and precious metals	Numerous quartz veins, fractures, faults, shear and breccia zones, metallic mineral pods, and local syenite and aplite dikes cut andesite and quartz monzonite. Faults and vein trends are northwest to northeast. Host rocks, especially local rhyolite bodies, are generally propylitically altered, although rocks near the Hidden Hill and the Big Horn faults are silicified, sericitic, and intensely bleached. Quartz veins, 1 to 6 in. thick, strike N15°W to N15°E, and dip from 40°W to 70°E, are colorless to white, and some are blue. Some veins contain comb structures or are brecciated and cemented with clay or chlorite. Many contain limonite or iron-oxide stain. Blue and green fluorite veins occur locally; fluorite and quartz fill faults, fractures, and some dike-host contacts. Pyrite, chalcopyrite, malachite, azurite, magnetite, limonite, and manganese oxide are also present. Mine workings consist of 10 cuts, 14 pits, 13 adits as much as 250 ft. long, 4 declines, and 2 shafts as deep as 40 ft. The prospect may have vein-type gold, disseminated gold, and a porphyry copper/molybdenum resource. Anomalous gold, silver, lead, zinc, copper, and molybdenum values were detected in rock samples collected at mine by U.S. Bureau of Mines. Total of 111 samples were collected and analyzed.	Miller & others, 1985, p. 27 Munts, 1984, p. 28

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
84	*Hidden Hills mine	8N	14E	5/6	Base and precious metals	One major quartz vein and numerous smaller quartz veins, breccia zones, shears, faults, and gouge zones cut andesite. Near veins andesite is silicified and altered to clay, with various amounts of chlorite and epidote. The principal quartz vein has a strike length of 325 ft., pinches and swells from 1 to 18 in. thick, and has an average thickness of 6 in. It strikes N30°E, dips 20°W, and contains both colorless and white quartz with local comb structure and vugs; some vugs are filled with limonite. Locally, the vein footwall is bounded by a 1 to 6 in. clay or breccia layer. Pyrite and chalcopyrite occur in the main vein; orpiment, realgar, manganese oxides, limonite and malachite occur in minor parallel, en echelon, and crosscutting quartz veins. The property contains a small abandoned mill, 2 cuts, 13 pits, 3 shafts, and 1 adit with approximately 800 ft. of workings on four levels. Recorded production for pre-1907 mining was 1,602 oz. gold; between 1913 and 1919, 1,000 tons of ore yielded 2,078 oz. gold. U.S. Bureau of Mines calculates that the mine dump contains approximately 4,000 tons of rock averaging 0.08 oz/ton gold and 0.08 oz/ton silver. Mine has about 550 tons of subeconomic quartz-vein resources averaging 0.60 oz/ton gold. Assuming a 4 ft. mining thickness is necessary, this would result in 4,000 tons of vein resources averaging 0.09 oz/ton gold. Mine may have additional gold the vein.	Miller & others, 1985, p. 18 Munts, 1984, p. 27
85	*Lucky Bird Nos. 1 and 2	8N	13E	14	Placer Gold	Alluvial fan cut by arroyos. No workings. Single plan sample contained no detectable gold.	Miller & others, 1985, p. 18 Munts, 1984, p. 20

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
86	Harper Perlite prospect	8N	13E	22	Perlite	10 to 30 ft. thick deposits of vitrophyric volcanic flows underly and overly banded rhyolite flows in the Van Winkle Mountains. The deposits could exhibit perlitic structure locally.	Wright & others, 1953, p. 188
87	*B.C. prospect	10N	14E	35	Iron	Weathered, Precambrian, metamorphosed, intrusive rocks with iron staining, abundant epidote and rare magnetite veinlets. One minor shear zone strikes N20°E is vertical and contains minor magnetite. This area coincides with a significant aeromagnetic anomaly. The magnetite skarn pod at the Adams-Ikes Hope prospect may be related to this deposit. Workings consist of 2 bulldozer cuts, 2 pits, and a slant drill hole of unknown depth; workings spread over about °-mile^2.	Moyle & others, 1986, p. 299
88	*Adams-Ikes Hope prospect	10N	15E	6/7	Iron	Lower workings are on shear zones oriented N50°W, vertical and N75°E, 85°SE in metamorphosed rocks; one is intruded by a vuggy, clear, 8 in. thick quartz vein containing pyrite, chalcopyrite, iron-oxides, and secondary copper minerals. Upper workings are on a N10°E trending skarn lens of pyrite and magnetite with epidote and garnet. The lens is approximately 50 ft. wide and is traceable by float for as much as 200 ft. downslope. Workings consist of one 15 ft. shaft and 2 pits on quartz and alteration zones; one 20 ft. adit and one pit are on the magnetite zone. Anomalous values of gold, silver, copper, and lead detected in samples collected from lower working by U.S. Bureau of Mines.	Moyle & others, 1986, p. 300

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
89	*Grande I-7 mine	10N 11N	15E 14E	6 35	Base and precious metals	One prominent vein system trends northwest, dips northeast, and crops out for at least 400 ft. The structure is exposed for 140 ft. vertically, averages 2.7 ft. thick, and contains veins, pods, and blebs of quartz in a gray-green gouge. Nearby, 3 veins and shear zones cut granitic rock; one contains red jasper with galena and minor secondary copper minerals. Development work consists of a 90 ft. adit with an 8 ft. winze, two 15 ft. adits, and 5 pits. Vredenburgh (1982) reported 100 tons of unknown type ore produced in 1980 from this or the Max Dor 1 and 2 mine. Anomalous values of gold, silver, and copper detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 300 Vredenburgh, 1982, p. 48
90	*Raindrop prospect	11N	14E	36	Base and precious metals	Localized, 0.5 ft. thick, white quartz veins are oriented N60°E, 72°NW and N28°W, 24°NE in granitic rock; quartz contains abundant limonite pseudomorphs after pyrite. Surface workings consist of three trenches, 40 to 100 ft. long. No significant metal values detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 300

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
91	*Gold Star North 1-44 prospect	11N	15E	31	Base and precious metals	Variably-trending, generally easterly-dipping, localized, 0.1 to 2.8 ft. thick shear zones and narrow quartz veins are associated with a northeast-trending, up to several hundred ft. wide zone of pervasively and intensively altered intrusive rock. This is a north extension of the Gold Star 1-10 prospect. Quartz is white to clear and contains pyrite, limonite pseudomorphs after pyrite, siderite, specularite, chrysocolla, malachite, azurite, and possible chalcopyrite. Workings consist of one 50 ft. deep inclined shaft, 2 adits, 20 and 60 ft. long, and 7 pits. Anomalous values of gold, silver, and copper detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 301
92	*Max Dor 1 & 2 mine	10N	15E	5/8	Base and precious metals	Two major structures: an east-trending, north-dipping quartz vein crops out discontinuously for 2,000 ft. and a 300 ft. spur, and a northwest trending, northeast-dipping fault exposed for about 350 ft. in granitic rocks. The 0.6 to 6.5 ft. thick quartz vein is white to clear and contains pyrite, chalcopyrite, malachite, and azurite. The fault is 1 ft. thick and composed of green gouge with quartz. Development work consists of 3 small pits, an open pit, 4 trenches, 2 bulldozer cuts, and a 47 ft. shaft with 25 ft. of crosscuts and drifts. Vredenburgh (1982) reported 100 tons of unknown type ore produced in 1980 from this or the Grande 1-7 mine. Anomalous values of gold, silver, copper, and lead were detected in rock samples collect by U.S. Bureau of Mines.	Moyle and others, 1986, p. 301 Vredenburgh, 1982, p. 50

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
93	*Prospect	10N	15E	7	Base and precious metals	A North-trending, 30° to 50°W, dipping 4 in. to 1 ft. thick quartz vein is exposed for 90 ft. in a shear zone cutting metamorphosed igneous rock. The shear is composed of punky clay gouge and limonite, and the quartz contains visible galena. Workings consist of one 90 ft. long adit with at least a 40 ft. partially-caved crosscut, and one 40 ft. trench. Anomalous values of silver and lead were detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 301
94	*Pink Falcon prospect	10N	15E	8	Base and precious metals	Several graphic textured, generally northwest-trending 1 to 3 ft. thick dikes with pink to purple feldspar, abundant white to clear quartz, and minor biotite are exposed for about 20 ft. Some quartz exhibits comb structures with hematitic jasper banding. Hornblende diorite county rock exhibits intense to sericite and chlorite alteration. Development work consists of 3 shafts, 10 to 20 ft. deep. No significant metal content detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 301
95	*Gold Star 1-10 prospect	10N	15E	8	Base and precious metals	Localized, north-trending, east-dipping, 0.5 to 7.8 ft. thick quartz veins and shear zones are along a 60 to 400 ft. wide zone of pervasively and intensively-altered intrusive rock. This is a south extension of the Gold Star North 1-44 prospect (Plate 1, no. 91). The altered zone extends for approximately one mile along a north-northeast trend. Development work consists of 4 inclined shafts, 17 to 55 ft. deep, including 55 ft. of drifts, 2 trenches, and 6 pits. Some samples collected by U.S. Bureau of Mines contained anomalous values of gold.	Moyle & others, 1986, p. 301

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
96	*Lou-A1-Mark Nos. 1-3 prospect	10N	15E	18	Base and precious metals	A north-trending, vertical zone of fault gouge 1.3 ft. thick with silicified hematite-limonite strings occurs in granitic country rock. The surface expression along the drainage between pits is approximately 500 ft. Surface workings consists of 2 pits. No significant metal content detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 302
97	*Prospect	10N	15N	17	Base and precious metals	Fault and shear zones strike north to northwest, dip moderately west, and are associated with quartz fillings in granite gneiss country rock. The main zone crops out discontinuously for 320 ft. and contains narrow (less than 6 in. wide) quartz veins and lenses. Other than minor galena, no significant minerals were observed. Workings consist of 2 inclined shafts, 25 and 70 ft. deep, one 30 ft. adit, and 6 pits. No gold or silver content detected in samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 302
98	*Prospect	10N	15E	17	Base and precious metals	Localized shear zones in granite gneiss strike N85°W and dip 33°SW. One contains an aplite dike with abundant chrysocolla staining and the other contains 1 to 3 in. thick veins with drusy and comb quartz structures. Sinuous cavities in the quartz are filled with bladed barite up to 1 in. long with interstitial galena and chlorite. Surface workings consist of 2 pits and 2 small trenches. Anomalous values of silver, lead, and copper detected in 2 samples collected by U.S. Bureau of Mines.	Moyle & others, 1986, p. 302

		LOCATION					
LOCALITY NO.	NAME	T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
99	*Silver Dutches prospect	10N	15E	18	Base and precious metals	A 2 ft. thick quartz vein, bordered by fault gouge in granitic rock, strikes N17°W and dips 82°N with pyrite and iron oxide in fractures. Workings consist of 2 pits and 1 collapsed shaft or adit. One chip and one select sample collected by U.S. Bureau of Mines: no gold or silver detected.	Moyle & others, 1986, p. 302
100	*Prospect	10N	15E	17	Base and precious metals	Argillized alaskite dike 8 ft. thick trends N10° to 20°W in pegmatite granite; only locally exposed. Surface workings consist of one pit. One random chip sample was collected; no gold, silver, or copper detected.	Moyle & others, 1986, p. 302
101	Gold Hammer mine	8N	15E	12	Base and precious metals	Series of 1 to 3 ft. thick quartz veins striking north and dipping 5° to 10°E. Several pits and 60 ft. and 180 ft. deep inclined shafts. Several samples collected from vein exposed at portal of main inclined shaft contain anomalous amounts of gold, copper, and lead (Samples 3vb, GH-1, and 3v-10; Appendix C).	Wright & others, 1953, p. 259-Gold
102	Prospect	8N	15E	13	Base and precious metals	Several prospect pits are located along traces of milky-white, locally-brecciated quartz veins up to 18 in. thick. Narrow gouge zone on both hanging and footwall sides of vein. Sparse pyrite present. Veins oriented N70°E to 45°S and N50°W to W70°N. Country rock is diorite. An analysis of a sediment sample collected from the gully draining this area showed anomalous content of molybdenum, and lead (Sample 35, Appendix C).	Southern Pacific Company, 1959, T. 8 N., R. 15-16. E

LOCALITY NO.	NAME	LOCATION T.	R.	SEC.	COMMODITIES	COMMENTS	SELECTED REFERENCES
103	Prospect	8N	16E	18	Base and precious metals	One ft. thick, milky white, brecciated quartz vein oriented N40°E to 55°S is explored by 2 shafts spaced about 200 ft. apart. The lower shaft is inclined, oriented S40°E to 55°S, and appears to be about 30 ft. deep. The upper shaft is oriented similarly and is about 20 ft. deep. Both are sunk on the footwall. Abundant manganese present in vein and along the 10 ft. thick shear zone on hanging wall. Country rock is diorite. Grab samples collected from the mine dump of the upper shaft shows anomalous copper, lead, zinc, arsenic, bismuth, and gold (Grab samples 2v, 40-2v, and 80-2v; Appendix C).	Southern Pacific Company, 1959, T. 8 N., R. 15-16 E.
104	Clipper Mountain Tungsten mine	8N	15E	23	Tungsten (scheelite)	Two tactite zones occur in limestone near the contact with quartz diorite. One zone trends northeast with nearly vertical dip and the second strikes northwesterly, dipping 60°SW. The zones were developed by adits, shafts, and cuts in the early 1950s. Only 150 tons of ore yielding 96 units of WO_3 have been produced.	Wright & others, 1953, p. 146
105	Prospect	8N	16E	19	Tungsten	Ferberite prospect.	Southern Pacific Company, 1959, T. 8 N., R. 15-16 E.
106	Prospect	8N	16E	19	Tungsten	Ferberite prospect.	Southern Pacific Company, 1959, T. 8 N., R. 15-16 E.
107	Prospect	9N	16E	11	----------	Vertical shaft exceeding 200 ft. in depth in felsic granitoid rock. No veining or alteration apparent at surface.	----------

APPENDIX B

MINERAL RESOURCE/RESERVE CLASSIFICATION NOMENCLATURE

APPENDIX B
MINERAL RESOURCE/ RESERVE CLASSIFICATION

Nomenclature

The following are definitions of the nomenclature associated with the California Mineral Land Classification diagram. It is important to refer to these definitions when studying the different resource categories shown on Figure 3.

RESOURCE: A concentration of naturally occurring, solid, liquid, or gaseous material in or on the earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

RESERVES: That part of the reserve base which could be economically extracted or produced at the time of determination. The term reserves need not signify that extraction facilities are in place and operative.

ORIGINAL RESOURCE: The amount of resource before production.

IDENTIFIED RESOURCES: Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified resources include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into measured, indicated and inferred.

MEASURED RESERVES: Quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes; grade and (or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are farther apart or otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

INDICATED RESERVES: Quantity and grade and (or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

DEMONSTRATED: A term for the sum of measured plus indicated reserves.

INFERRED RESOURCES: Estimates are based on an assumed continuity beyond measured and (or) indicated resources, for which there is geologic evidence. Inferred resources may or may not be supported by samples or measurements.

MARGINAL RESERVES: What part of the resource base which, at the time of determination, borders on being economically producible. The essential characteristic here is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

ECONOMIC: This term implies that profitable extraction or production under defined investment assumptions has been established, an analytically demonstrated, or assumed with reasonable certainty.

SUBECONOMIC RESOURCE: The part of identified resources that does not meet the economic criteria of reserves and marginal reserves.

UNDISCOVERED RESOURCES: Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. Undiscovered resources may be postulated in deposits of such grade and physical location as to render them economic, marginally economic or subeconomic. To reflect varying degrees of geologic certainty, undiscovered resources may be divided into two parts:

HYPOTHETICAL RESOURCES: Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resources.

SPECULATIVE RESOURCES: Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources.

APPENDIX C

GEOCHEMICAL ANALYSES

1ACME ANALYTICAL LABORATORIES 852 E. HASTINGS ST. VANCOUVER B.C. W6A 1R6 PHONE 253-3158 DATE LINE 251-1011

GEOCHEMICAL ICP ANALYSIS

.500 GRAM SAMPLE IS DIGESTED WITH 3-1-2 NCL-IM03-N20 AT 95 DEG.C FOR ONE HOUR AND IS DILUTED TO 10 FL WITH WATER
THIS LEACH IS PARTIAL FOR MN FE CA P CR NS BA TI B AL KA K N SI ZR CE SN V KB AND TA. AU DETECTION LIMIT BY ICP IS 3PPM
SAMPLE TYPE: Rock chips AU: ANALYSIS BY AA FROM 10 GRAM SAMPLE

DATE RECEIVED: APRIL 24, 1987 DATE REPORT MAILED, _____ ASSAYER _____ DEAN TOYE, CERTIFIED B.C. ASSAYER

DIVISION OF MINES AND GEOLOGY (SACRAMENTO) File # 87-1081

SAMPLES	MO PPR	CU PPR	PB PPR	ZN PPR	AG PPR	N1 PPR	CO PPR	PPR	FE PPR	AS PPR	U PPR	AU PPR	TM PPR	SR PPR	CB PPR	GB PPR	DI PPR	V PPR	CA %	P %	LA PPR	CR PPR	AG %	SA PPR	1 1 %	B PPR	AL %	KA %	K %	N PPR	AUS PPR
1S	1	12	28	53	.3	10	5	316	2.36	7	5	MD	10	49	1	2	2	37	.59	.059	22	17	.61	84	.09	8	1.12	.02	.30	1	9
2S	3	64	10	76	.1	36	23	431	6.14	2	5	MD	6	59	1	2	2	163	1.14	.081	15	93	1.42	141	.16	9	1.95	.07	.64	23	1
3S	3	26	17	71	.1	11	15	531	10.35	8	5	MD	11	30	1	2	2	159	.99	.242	25	35	.91	115	.12	3	1.34	.02	.54	3	1
4S	20	65	279	76	.3	23	12	503	4.86	11	5	MD	13	39	1	2	2	78	.94	.123	27	63	.99	139	.13	5	1.62	.03	.55	2	2
6S	4	24	13	99	.2	28	11	627	6.64	3	5	MD	17	60	1	2	2	56	1.54	.163	31	55	.94	146	.13	3	1.45	.02	.65	1	3
7S	4	18	19	68	.3	13	9	439	13.92	2	5	MD	60	27	1	2	2	78	.82	.080	30	48	.46	69	.13	3	.89	.02	.33	2	1
8S	5	31	17	65	.3	13	7	441	7.97	3	7	MD	31	33	1	2	2	49	.77	.097	31	36	.43	80	.60	4	.80	.02	.20	1	48
9S	2	13	8	59	.3	11	5	373	3.27	4	7	MD	19	24	1	2	2	29	.48	.083	26	21	.42	88	.10	4	.94	.02	.37	2	4
10S	3	14	13	61	.2	10	7	365	8.04	3	5	MD	38	24	1	2	2	55	.47	.078	28	35	.40	71	.10	3	.83	.02	.31	5	1
11S	2	14	14	55	.3	12	6	389	5.02	2	5	MD	26	22	1	2	2	41	.50	.100	30	30	.34	69	.10	2	.69	.02	.23	1	1
13S	1	20	8	48	.1	30	8	311	2.97	4	5	MD	9	52	1	2	2	53	1.37	.052	21	51	.73	111	.11	8	1.44	.02	.30	1	2
14S	2	16	15	48	.2	24	9	317	4.53	5	5	MD	21	44	1	2	2	94	.92	.051	19	55	.54	86	.13	5	.88	.02	.23	2	1
15S	2	17	11	47	.3	24	7	307	2.72	5	5	MD	12	46	1	2	2	48	.82	.057	19	37	.69	97	.11	7	1.12	.02	.28	2	1
16S	1	17	11	44	.2	29	7	313	2.71	2	5	MD	10	47	1	2	2	49	1.05	.056	19	40	.69	103	.12	7	1.06	.03	.27	1	1
17S	1	19	10	50	.2	26	8	334	2.80	3	5	MD	9	50	1	2	2	50	1.11	.063	20	48	.76	112	.13	6	1.27	.03	.32	1	1
18S	2	22	13	69	.2	39	14	496	7.67	2	5	MD	13	40	1	2	3	135	.55	.093	26	160	.65	91	.24	3	.07	.04	.20	1	1
19S	2	31	9	54	.2	34	14	400	4.87	5	5	MD	11	38	1	2	2	100	.61	.112	24	73	.83	106	.14	3	1.14	.04	.32	1	1
20S	2	19	14	68	.2	16	10	437	7.16	4	6	MD	18	39	1	2	2	84	.64	.145	28	52	.61	129	.14	4	1.15	.02	.49	1	1
21S	2	14	21	62	.2	12	7	390	5.21	2	5	MD	18	27	1	2	2	48	.45	.086	26	29	.53	99	.12	3	1.10	.02	.42	1	2
22S	1	16	14	64	.2	13	7	380	3.44	6	5	MD	18	33	1	2	2	44	.53	.074	27	25	.67	114	.12	5	1.34	.02	.47	1	1
23S	1	18	10	50	.1	34	11	400	3.98	6	5	MD	13	40	1	2	2	83	.78	.068	25	74	.67	103	.15	4	1.01	.03	.21	1	1
24S	1	25	9	54	.1	22	16	366	7.76	3	5	MD	11	36	1	2	2	174	.93	.150	22	67	.79	105	.14	2	1.13	.03	.28	1	1
25S	1	30	19	62	.1	22	18	427	12.98	9	7	MD	30	40	1	2	2	290	1.43	.269	42	129	.86	160	.12	2	1.42	.03	.47	1	1
26S	2	22	13	68	.3	14	13	478	6.10	3	5	MD	11	41	1	2	2	114	1.54	.277	32	30	.97	157	.15	3	1.51	.03	.55	2	1
27S	1	34	10	66	.1	25	15	418	6.11	2	5	MD	10	45	1	2	3	132	1.26	.126	24	74	.99	139	.15	2	1.52	.04	.51	8	1
30S	1	27	16	52	.1	15	19	343	9.22	4	5	MD	17	30	1	2	2	203	.88	.226	33	37	.68	116	.16	2	1.11	.03	.35	1	1
31S	1	31	12	68	.1	14	16	440	6.01	4	5	MD	13	34	1	2	2	130	.95	.214	29	26	1.02	174	.21	3	1.50	.03	.56	1	2
32S	1	36	14	78	.1	16	16	484	6.11	2	5	MD	14	45	1	2	2	121	1.33	.235	31	26	1.28	205	.25	3	1.73	.03	.57	2	1
34S	1	32	16	70	.1	16	14	467	5.06	2	5	MD	18	40	1	2	2	96	1.22	.195	31	24	1.13	183	.21	4	1.68	.03	.50	1	1
35S	1	30	8	58	.2	15	15	370	5.77	2	6	MD	25	38	1	2	2	120	.90	.199	33	27	.92	159	.20	3	1.36	.03	.45	1	1
36S	2	23	14	38	.1	15	20	256	18.51	3	7	MD	35	23	1	2	2	413	.47	.116	27	54	.36	64	.11	2	.69	.02	.19	1	1
37S	1	27	21	45	.2	19	16	326	9.27	2	5	MD	36	32	1	2	2	187	.98	.209	36	58	.56	87	.11	3	.87	.02	.23	2	1
38S	1	20	16	46	.2	12	13	321	9.08	3	5	MD	45	29	1	2	2	168	.79	.176	42	40	.53	89	.12	3	.91	.02	.24	1	1
39S	3	10	19	235	.2	8	9	1063	11.53	2	5	MD	23	17	1	2	2	150	.76	.031	44	42	.21	43	.26	3	.50	.02	.13	1	1
40S	1	24	20	87	.1	21	19	498	14.55	2	6	MD	15	36	1	2	2	335	.55	.108	32	108	.47	58	.13	2	.78	.02	.21	1	1
42S	1	31	30	72	.1	18	19	508	18.54	7	8	MD	37	29	1	2	2	350	.93	.170	37	81	.64	118	.14	2	1.00	.02	.27	1	1
STD	19	55	39	126	6.9	64	26	952	3.91	38	19	6	32	45	16	17	22	60	.48	.094	34	58	.88	169	.08	38	1.72	.06	.12	12	53

DIVISION OF MINES AND GEOLOGY (SACRAMENTO) File # 87-1081

SAMPLES	MO PPR	CU PPR	PB PPR	ZN PPR	AG PPR	N1 PPR	CO PPR	PPR	FE PPR	AS PPR	U PPR	AU PPR	TM PPR	SR PPR	CB PPR	GB PPR	DI PPR	V PPR	CA %	P %	LA PPR	CR PPR	AG %	SA PPR	1 1 %	B PPR	AL %	KA %	K %	N PPR	AUS PPR
43S	1	31	17	70	.3	15	13	465	5.09	2	5	MD	12	35	1	2	2	98	.97	.174	29	31	.91	130	.15	4	1.44	.02	.43	1	7
44S	1	13	14	39	.2	9	8	235	5.13	2	5	MD	19	27	1	2	2	103	.56	.099	24	24	.43	70	.08	3	.01	.02	.22	2	2
45S	2	17	21	54	.4	10	12	345	13.72	2	5	MD	31	30	1	2	2	222	.93	.282	59	34	.49	101	.10	3	.93	.02	.29	1	6
46S	2	12	14	49	.2	8	9	356	5.58	2	5	MD	22	29	1	2	2	85	1.07	.336	44	17	.49	81	.12	3	.91	.02	.29	1	1
47S	1	26	36	83	.5	13	12	446	5.68	2	5	MD	16	32	1	2	2	140	.55	.113	30	70	.80	122	.16	2	1.28	.03	.40	1	6
49S	2	28	25	97	.3	17	14	588	0.55	2	5	MD	21	37	1	2	2	167	.73	.160	36	51	.88	137	.16	10	1.42	.03	.48	1	2
50S	1	31	37	87	.5	19	15	398	7.67	2	5	MD	15	29	1	2	2	214	.56	.128	31	43	.75	106	.15	2	1.13	.03	.33	1	4
51S	1	26	13	65	.2	12	11	420	3.26	2	5	MD	9	108	1	2	2	55	1.07	.177	28	10	.77	187	.11	6	1.89	.10	.37	1	1
53S	1	11	47	55	1.0	6	3	313	1.50	3	5	MD	6	35	1	2	2	22	10.50	.043	12	12	4.77	55	.05	3	.61	.03	.16	1	3
54S	1	8	17	31	.1	7	4	298	2.08	2	5	MD	11	21	1	2	2	33	.30	.035	25	12	.29	83	.05	3	.66	.01	.20	1	17
55S	2	10	26	35	.1	7	5	360	1.69	4	5	MD	12	23	1	2	2	25	.26	.034	26	14	.30	99	.06	3	.70	.02	.21	1	2
56S	1	13	19	50	.3	9	6	492	1.94	2	5	MD	9	32	1	2	2	28	.37	.047	19	13	.48	107	.07	6	1.09	.02	.33	1	1
57S	1	26	23	52	.5	12	9	535	2.08	6	9	MD	7	54	1	2	2	33	5.71	.054	20	14	1.25	210	.05	5	1.13	.05	.22	1	5
13P	1	13	8	27	.1	48	10	539	2.32	2	5	MD	5	22	1	2	2	59	.54	.041	17	106	.49	72	.15	3	.34	.03	.06	1	4
10P	2	20	15	87	.1	39	17	708	16.14	2	5	MD	40	15	1	2	0	219	.31	.066	21	302	.31	84	.41	2	.27	.03	.08	15	2
19P	1	45	14	52	.1	38	23	532	11.30	6	5	MD	21	24	1	2	2	222	.48	.098	28	154	.62	97	.22	6	.62	03	.21	3	2
20P	2	27	21	52	.3	17	14	444	15.20	3	5	MD	36	61	1	2	2	173	.63	.194	42	105	.30	109	.17	3	.56	.02	.24	1	2
1V	23	39	8	130	.4	30	15	1645	5.41	7	8	MD	8	416	1	2	2	45	1.91	.061	38	22	1.01	131	.02	31	1.78	.87	.66	1	1
40-2V	2	329	3415	002	.4	7	11	607	3.01	25	5	2	1	9	3	3	24	315	.12	.015	12	4	.25	32	.01	6	.44	.01	.11	1	1560
80-2V	1	501	9577	1320	1.0	11	18	1064	4.50	53	5	7	1	20	4	9	35	1060	.23	.032	18	7	.43	54	.02	2	.79	.01	.19	3	2420
3V-10	4	1807	1099	81	.5	15	29	796	4.53	52	5	MD	9	50	1	2	6	399	5.53	.111	48	15	.94	158	.04	2	1.41	.05	.20	3	1650
4V	1	34	34	37	.1	1	1	961	1.05	2	5	MD	31	29	1	2	3	12	.21	.028	40	1	.17	41	.01	2	.44	.02	.12	1	20
QI-1	1	15	15	45	.3	13	6	333	1.95	10	5	MD	9	171	1	2	2	32	3.98	.051	15	16	.66	118	.08	8	1.13	.04	.32	1	5
STD	20	56	38	129	6.7	67	27	979	3.97	39	15	7	33	46	17	16	21	62	.48	.099	35	59	.88	173	.08	35	1.72	.07	.13	12	50

1ACME ANALYTICAL LABORATORIES 852 E. HASTINGS ST. VANCOUVER B.C. W6A 1R6 PHONE 253-3158 DATE LINE 251-1011

GEOCHEMICAL ICP ANALYSIS

.500 GRAM SAMPLE IS DIGESTED WITH 3-1-2 NCL-IM03-N20 AT 95 DEG.C FOR ONE HOUR AND IS DILUTED TO 10 FL WITH WATER
THIS LEACH IS PARTIAL FOR MN FE CA P CR NS BA TI B AL KA K N SI ZR CE SN V KB AND TA. AU DETECTION LIMIT BY ICP IS 3PPM
SAMPLE TYPE: Rock chips AU: ANALYSIS BY AA FROM 10 GRAM SAMPLE

DATE RECEIVED: APRIL 24, 1987 DATE REPORT MAILED, _____ ASSAYER _____ DEAN TOYE, CERTIFIED B.C. ASSAYER

DIVISION OF MINES AND GEOLOGY (SACRAMENTO) File # 87-1081

SAMPLES	MO PPR	CU PPR	PB PPR	ZN PPR	AG PPR	N1 PPR	CO PPR	PPR	FE PPR	AS PPR	U PPR	AU PPR	TM PPR	SR PPR	CB PPR	GB PPR	DI PPR	V PPR	CA %	P %	LA PPR	CR PPR	AG %	SA PPR	1 1 %	B PPR	AL %	KA %	K %	N PPR	AUS PPR
2v	3	320	2681	1042	1.2	4	3	132	7.14	39	5	6	1	3	7	5	3	49	.04	.003	2	2	.04	8	.01	8	.09	.01	.02	2	5840
3va	1	282	277	25	1.0	4	7	203	1.68	10	5	MD	7	21	1	2	2	55	4.86	0.46	21	2	.26	75	.04	2	.50	.04	.14	2	480
5v	1	689	271	131	.3	10	22	337	3.03	2	5	MD	1	22	1	2	2	74	.23	.027	2	18	.93	21	.03	2	1.15	.02	.08	1	112
33v	4	18	18	5	.1	6	102	30	15.34	9	7	MD	7	418	1	2	2	150	1.52	.158	17	6	.17	45	.18	6	.77	.24	.23	1	2
41v	5	18	12	1	.2	5	114	14	16.14	14	5	MD	6	100	1	2	2	96	.15	.034	10	1	.05	114	.02	8	.38	.09	.09	1	9
48v	77	97	17915	205	203.3	9	15	122	4.85	2	5	9	1	14	3	46	10	254	.06	.046	2	1	.02	26	.01	4	.05	.01	.09	1	27500
52v	2	6	96	61	.7	6	5	492	3.85	4	5	MD	16	17	1	2	2	18	2.55	.079	45	4	.08	47	.01	6	.43	.03	.15	1	8
58v	3	6	86	44	.6	41	14	656	5.63	65	7	MD	6	84	1	2	2	44	11.60	.156	31	24	1.28	449	.01	6	1.13	.06	.23	3	21
B-1	126	5259	310	1	29.1	3	8	88	49.39	1958	5	MD	4	20	1	21	6	21	.32	.007	4	15	.13	5	.01	21	.41	.01	.01	2	240
B8-1	1	53	102	3	2.1	2	5	17	1.26	6	5	4	34	46	1	2	4	3	.08	.029	96	1	.02	63	.01	3	.17	.09	.05	1	5120
B8-5	9	906	945	18	26.4	7	6	32	9.94	30	6	29	2	138	1	2	2	155	.43	.019	8	5	.05	704	.01	6	.26	.01	.09	1	27500
B8-15	6	7189	715	20	44.0	15	16	17	5.90	3	5	43	3	71	1	2	2	46	.03	.016	6	3	.02	255	.01	3	.12	.01	.06	1	52400
BH-1	74	30	15	5	.2	2	2	27	.59	10	5	MD	9	9	1	2	2	13	.63	.042	6	1	.06	241	.01	6	.86	.01	.38	1	240
FG-1	22	30	9	25	.3	6	3	541	1.44	6	8	MD	1	27	1	2	2	11	7.17	.001	10	2	.04	14	.01	8	.07	.06	.02	1	90
GH-1	17	858	4772	22	3.8	3	4	112	4.28	2	5	5	2	10	1	5	17	355	.13	.022	11	1	.02	65	.01	2	.21	.01	.13	3	4805
N-1	4	34	27	14	.5	8	14	1689	1.17	2	5	MD	2	17	1	2	2	31	7.27	.036	12	8	.09	175	.01	441	.96	.07	.44	1	178
OI-1	1	5	12	3	.1	7	3	123	1.03	104	5	MD	1	1545	1	2	4	13	37.63	.006	2	2	.24	28	.01	7	.05	.01	.01	5	4
OI-2	1	7	6	13	.2	9	5	650	2.33	176	5	MD	5	462	1	5	5	47	21.46	.029	2	1	.10	128	.01	5	.08	.04	.02	3	1
P-1	3	6413	9	15	9.6	10	39	284	2.94	6	5	6	8	47	1	2	5	8	1.26	.048	8	1	.10	40	.01	2	.30	.01	.19	1	10035
PI-1	1	137	40	1	1.2	2	46	29	6.54	8	5	MD	1	12	1	2	6	35	.29	.002	2	1	.01	9	.02	2	.04	.02	.04	1	144
K-1	11	19	7	6	.1	2	8	49	1.87	15	5	MD	3	22	1	2	4	21	.10	.019	12	3	.06	204	.01	5	.18	.01	.10	1	420
SQ-1	2	8397	16923	56148	200.4	4	16	30	2.71	2	5	MD	1	2	206	19	176	1	.02	.001	2	1	.01	15	.01	2	.09	.01	.08	1	210
Z8a-1	2	2154	37	161	.2	2	6	1278	1.59	6	5	MD	1	520	1	2	3	28	4.62	.024	6	4	.06	1014	.07	3	.51	.05	.27	1	44
149	29	131	58	84	.5	13	40	31	3.34	14	5	MD	1	25	1	2	2	48	.05	.002	2	1	.02	328	.01	10	.13	.01	.01	1	73
150	1	13	18	29	.3	4	3	316	2.44	9	5	MD	17	40	1	3	2	39	.15	.037	41	1	.05	1018	.01	6	.27	.02	.08	2	2

APPENDIX D

PRELIMINARY REPORT ON SELECTED AEROMAGNETIC ANOMALIES OF THE KERENS, FLYNN AND COLTON WELL 15-MINUTE QUADRANGLES, SAN BERNARDINO COUNTY, CALIFORNIA

By

Leslie G. Youngs

APPENDIX D

PRELIMINARY REPORT ON SELECTED AEROMAGNETIC ANOMALIES OF THE KERENS, FLYNN AND COLTON WELL 15-MINUTE QUADRANGLES, SAN BERNARDINO COUNTY, CALIFORNIA

INVESTIGATION OF AEROMAGNETIC ANOMALY V

The existence of a large magnetite deposit at what eventually became the Vulcan mine in the central Providence Mountains has been known since at least the turn of the century. The Kaiser Company, Inc. developed and produced iron ore from the Vulcan mine from 1941 to 1947. Early geophysical techniques (dip-needle surveys) were used in conjunction with drill holes to delineate the main ore body in 1943 (Lamey, 1948). Today, remnants of the early mining operations include a large open pit and a waste dump.

An aeromagnetic anomaly, with a maximum amplitude over background of about 1,000 gammas (nanoteslas), is centered near the original ore deposit at the Vulcan mine (aeromagnetic anomaly V, Figures 4 and 5). However, the aeromagnetic anomaly is greatly elongated eastward from the Vulcan mine through Foshay Pass. The eastward extension of the anomaly was selected for ground magnetic tests. Five ground magnetic traverses were made approximately perpendicular to the long axis of aeromagnetic anomaly V (traverses V-1 through V-5). The ground magnetic profiles are shown in Figures 6 and 7. Most of the profiles are annotated with geologic observations made during the surveys.

Traverse V-1 crosses a granitic rock/limestone fault contact at approximately 1,700 feet from the origin of the traverse. A thin (a few feet wide) magnetic-bearing skarn deposit is exposed at the contact. The profile of traverse V-1 shows a very large amplitude, but narrow negative anomaly over the skarn deposit. This anomaly has reversed magnetism. The profile also shows a 3,000 gamma amplitude differential between opposite sides of the fault contact with the higher amplitude to the east over the exposed limestone. This part of the profile may indicate one or more larger skarn deposits exhibiting "normal" magnetism lie beneath the exposed limestone. A field check with a hand magnet of the exposed rocks in this area did not reveal any rocks with sufficient magnetite content to cause the positive anomaly.

Similarly, the profile of traverse V-2 shows a large negative magnetic anomaly over another exposed segment of the magnetite-bearing skarn zone along the fault contact described above. The negative anomaly, which represents reversed magnetism, is defined by a 200-foot-wide trough in the profile from 1,400 to 1,600 feet from the origin of the traverse. The exposed skarn deposits only a few feet wide, but the broad width of the negative anomaly may suggest a wider skarn zone at depth. The profile also shows a large amplitude, double-spiked, positive anomaly from approximately 600 to 1,000 feet from the origin of the traverse. The positive anomaly, which is over granitic rocks, has a maximum amplitude of approximately 4,000 gammas over background. The anomaly appears to represent a zone of increased concentration of magnetite having normal magnetization either encompassed within or below the granite rocks. The shape of the positive anomaly suggests that the zone of higher magnetite concentrations is relatively near the surface.

The profile of ground magnetic traverse V-3 shows a very pronounced, broad, positive anomaly centered over the granitic rock/limestone fault contact (Figure 6). The maximum amplitude of the anomaly is approximately 2,200 gammas over background. A simple interpretation of the profile suggests that there is a magnetite-enriched zone possibly lying as much as 1,000 feet below the surface along this portion of the fault trace. A hand-held magnet was used to checkout crops in the immediate area of the fault. There were no rocks found on the surface which had a magnetite concentration sufficient to have caused the positive anomaly.

Ground magnetic traverse V-4 shows a positive anomaly over granitic rocks that extend into an area of alluvial and fan deposits (Figure 7). The maximum amplitude of the anomaly is approximately 1,250 gammas over background. The shape of the profile suggests that there may be a fault contact between limestone and granitic rocks at approximately 1,520 feet from the origin of the traverse. The fault is apparently buried beneath the sedimentary deposits. The positive anomaly (from 400 to 1,500 feet along the traverse from the origin) may represent a skarn-type mineral deposit related to the limestone/granitic rock fault contact or it may simply indicate a relatively-high concentration of magnetite in the granitic rocks south of the fault.

Ground magnetic traverse V-5 was run in an area at the far eastern extension of aeromagnetic anomaly V (Figure 5). The profile on Figure 4 shows a pronounced positive anomaly from about 2,800 to 4,400 feet from the origin of the traverse. The anomaly has a maximum amplitude of approximately 700 gammas over background. Granitic rocks quartz monzonite?) are exposed on a small ridge within the area of the positive anomaly. These rocks were checked in the field with a hand-held magnet, but none were found that might be the source of the anomaly. The source of this anomaly is unknown and appears to be hidden beneath the surface rock exposures.

Three samples of magnetite ore were randomly selected from the waste dump at the Vulcan mine for magnetic susceptibility measurements. The average magnetic susceptibility of the samples was 178,420 x 10^6 cgs units (2.2 SI units).

An outline of the zone judged favorable for magnetite mineralization is shown on Figure 5. This zone includes the positive anomalies from the ground surveys, the reversed magnetic anomalies known to be associated with exposed magnetite-bearing skarn deposits, the main ore body at the Vulcan

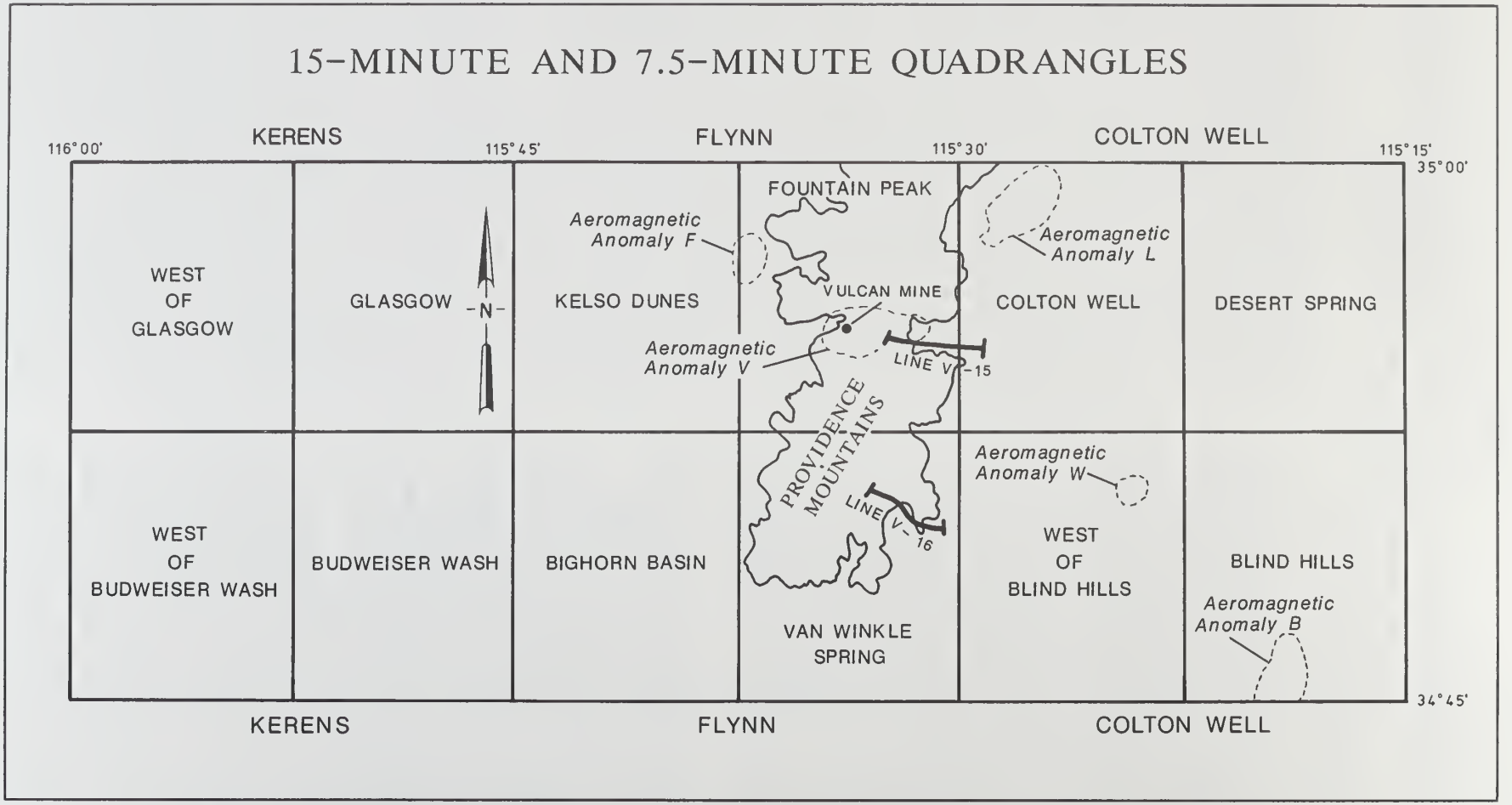
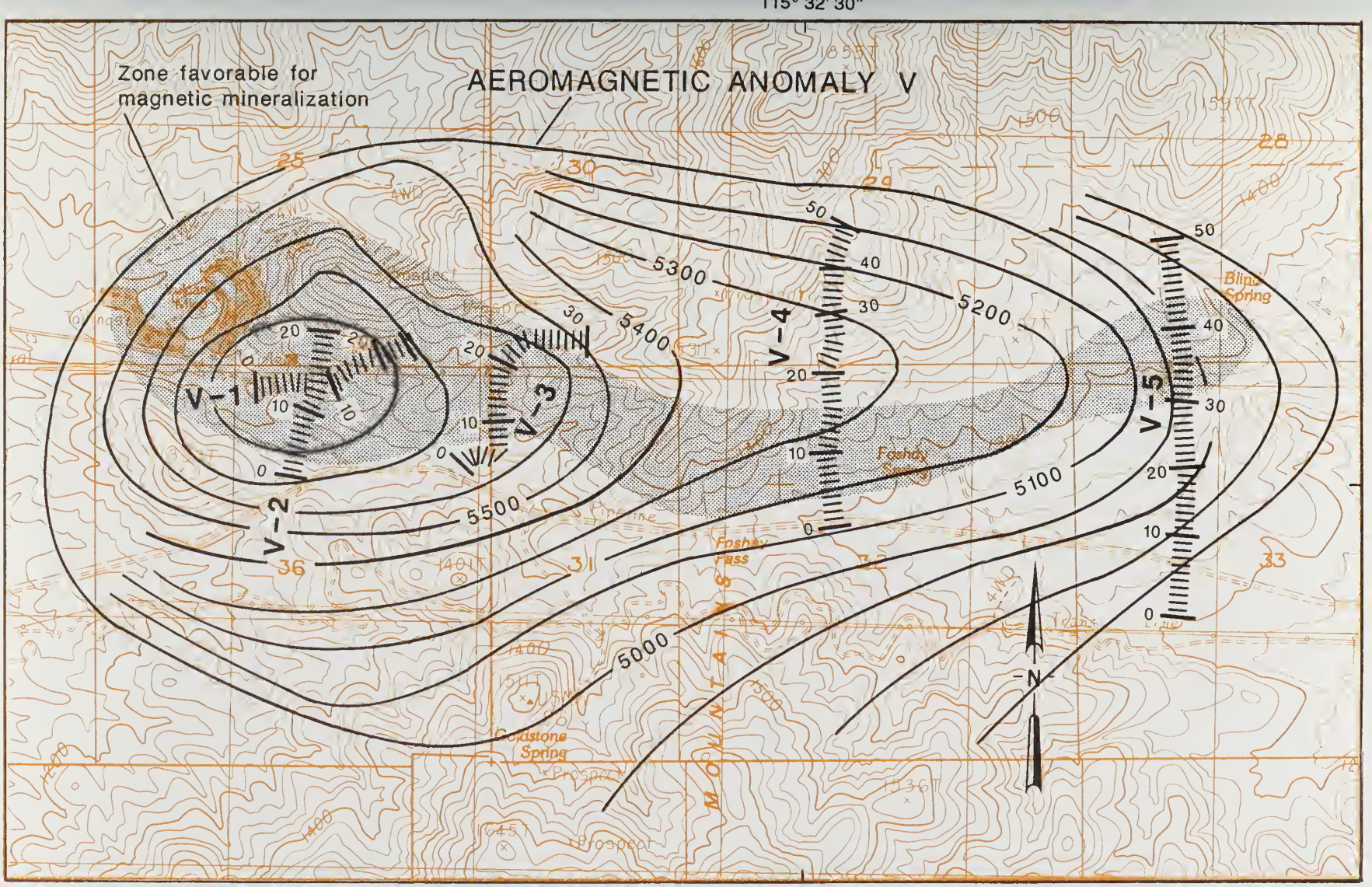
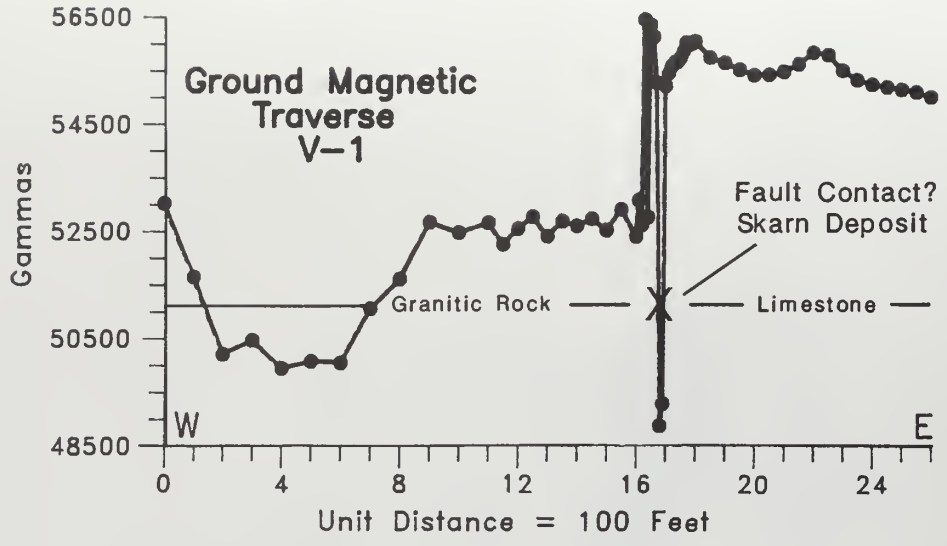


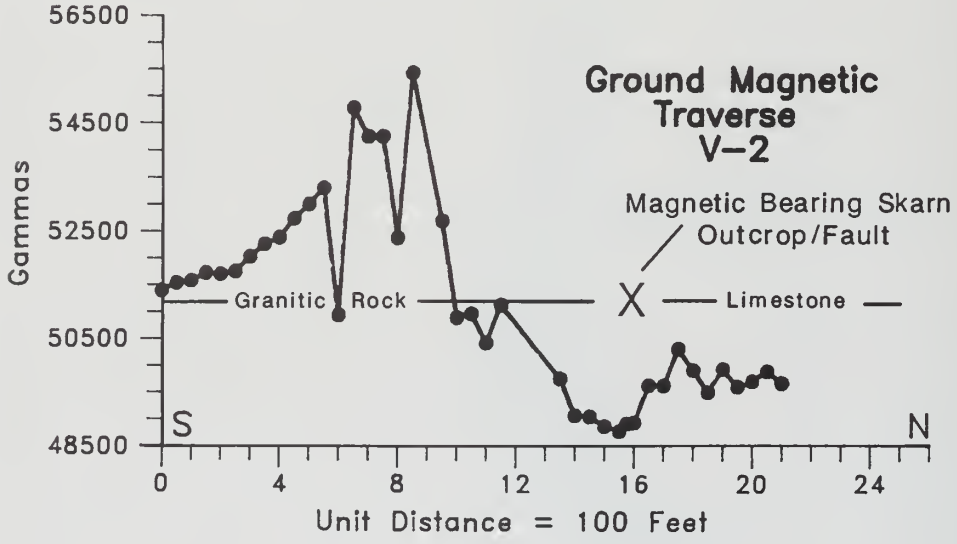
Figure 4. Quadrangle index map showing locations of selected aeromagnetic anomalies and ground magnetic survey lines V-15 and V-16. Not to scale.



Base map from the U.S. Geological Survey

Figure 5. Map of Foshay Pass area, central Providence Mountains showing locations of aeromagnetic anomaly V and ground magnetic survey lines V-1 through V-5. Scale 1:24,000.





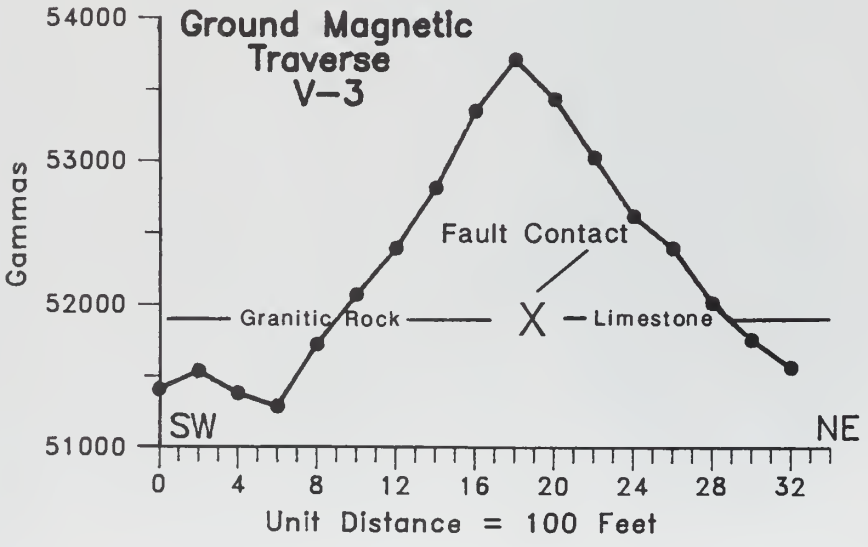
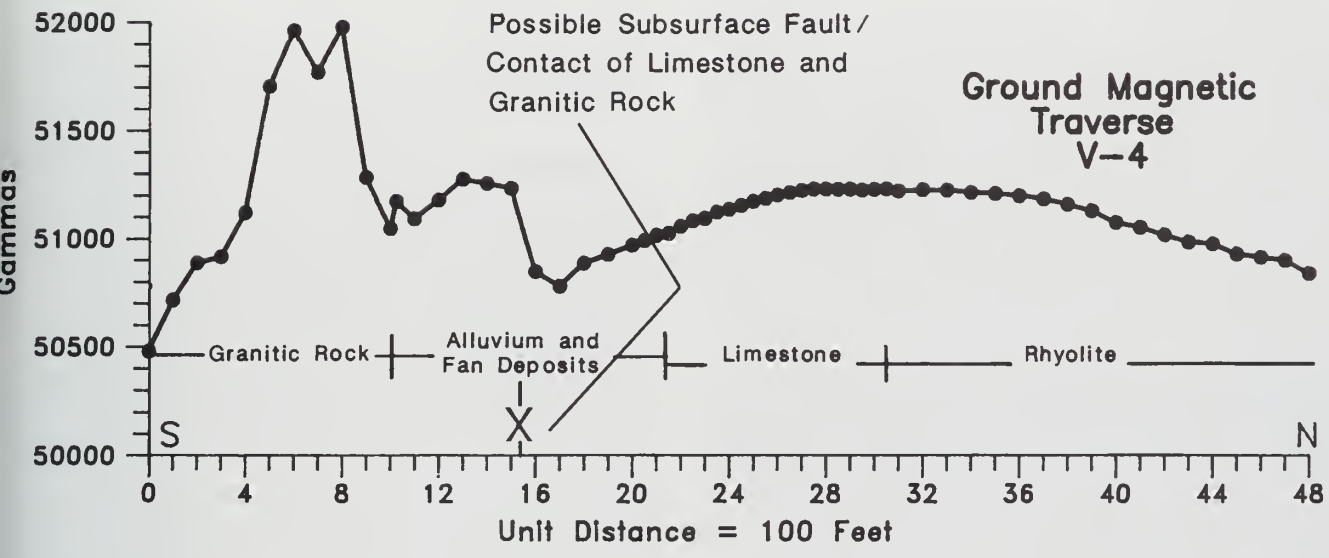


Figure 6. Ground magnetic traversesV-1 through V-3.



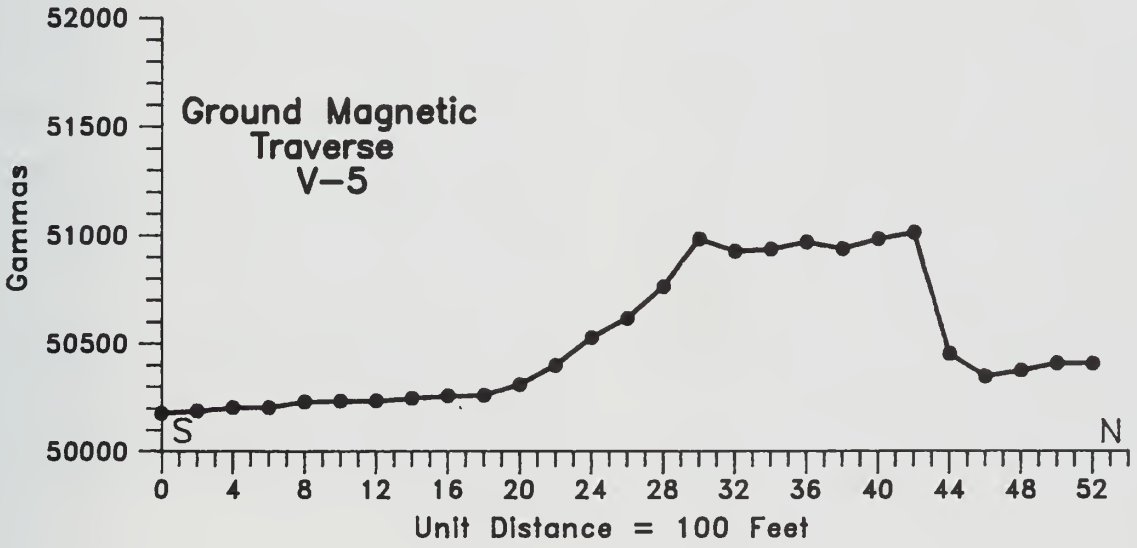


Figure 7. Ground magnetic traverses V-4 and V-5.

Mine site, and several small prospects. The zone shown in Figure 5 nearly coincides with the long axis of aeromagnetic anomaly V. This zone can be considered the most favorable area for exploration for magnetite deposits as well as other possible associated types of mineralization.

INVESTIGATION OF ANOMALY L

Aeromagnetic anomaly L is centered near the southwest border of a small valley that includes the 7IL Ranch in the northwestern corner of the Colton Well 7.5-minute quadrangle (Figures 4 and 8). The aeromagnetic anomaly has a maximum positive amplitude of approximately 600 gammas (nanoteslas) over background. Apparently, the U.S. Steel Corporation investigated this anomaly in the late 1950s. A few exploratory holes were drilled along the southeast boundary of the small valley in the vicinity of the center of the aeromagnetic anomaly (Figure 8). The results of U.S. Steel's exploratory work are unknown, but there has been no development of the site since these earlier studies.

In the coarse of the field work for this report, six ground magnetic traverses were conducted near the 7IL Ranch in an attempt to discover the source of the positive magnetic anomaly. The traverses are labeled V-6 through V-11 and their locations are shown on Figure 8. The magnetic profiles are shown in Figures 9 and 10. All of the profiles show positive magnetic anomalies. The anomaly with the largest amplitude was found on traverse V-10 (Figure 10). The amplitude of this anomaly may be as much as 5,500 gammas over background. However, the background level for that particular profile is somewhat difficult to judge. Profiles V-8, V-9 and V-11 also show positive magnetic anomalies of several thousand gammas over background. These are very large anomalies and suggest rocks with major concentrations of magnetite.

The ground magnetic data have been contoured on Figure 8 to show the aerial relationship of the magnetic data in the 7IL Ranch area. The ground magnetic contour map clearly shows a magnetic high (positive contour closure) near the southeast boundary of the small valley. The high is over alluvium and does not extend to the ridge-forming rocks that crop out along the southern border of the valley. Outcrops along the edges of the valley were field-checked with a hand-held magnet, but there were no rock types found with magnetite concentration sufficient to be the cause of this major anomaly. In short, the source of the anomaly is completely hidden beneath the valley fill.

A magnetic profile, A-A', was constructed from the contoured ground magnetic map across the magnetic high. The profile alignments shown on Figure 11 and the profile is shown on Figure 12. The profile was used in conjunction with a 2-dimensional modeling computer program to produce a model of the buried source of the positive magnetic anomaly. The computer program produces non-unique models by matching a theoretical curve calculated from the model parameters to the original magnetic profile. The model shown on Figure 12 is an elongated, magnetite-bearing zone dipping to the north. The theoretical magnetic susceptibility value of the ore body was chosen as 1.1 SI units. This value is approximately one-half of the magnetic susceptibility measured from th magnetite ore samples (2.2 SI units) at the Vulcan mine site miles to the southwest. The shallowest depth to the modeled or body is approximately 650 feet at the southern end. The model approximately 4,000 feet long and varies in thickness from 250 450 feet with the greater thickness in the center.

The approximate boundaries of a zone favorable for magne mineralization are shown on Figure 11. The zone was drawn to include the positive anomalies from the ground magnetic survey The extent of this zone coupled with the 2-dimensional model al cross section A-A' suggests that there may be a very sizable mag tite-bearing mass beneath the valley floor. Whether other types mineralization are associated with this body is unknown.

INVESTIGATION OF AEROMAGNETIC ANOMALY

Aeromagnetic anomaly B is located in the south-central por of the Blind Hills 7.5-minute quadrangle and is centered over th southeast end of a northwest-trending barren ridge composed of Precambrian gnessic rocks. The amplitude of the positive aeron netic anomaly is approximately 900 gammas over background. Ground magnetic traverse V-12 was run along the base of the ri and extended southeastward out onto the desert floor to define t magnetic anomaly (Figure 13). The profile of the ground survey 12) is shown on Figure 14. The profile shows a broad, positive ground-magnetic anomaly of approximately 800 gammas over b ground. The anomaly extends nearly the entire length of the ri from approximately 1,200 to 4,800 feet from the survey. The so of the moderately-high anomaly is probably a slight increase in concentration of magnetite in the rocks forming the ridge, comp to the gneissic rocks west of the ridge. The broad flat shape of th profile suggests that the magnetite is homogeneously dissemina throughout the ridge-forming rocks. The anomaly appears not t represent any magnetite-enriched zone of economic importance.

INVESTIGATION OF AEROMAGNETIC ANOMALY

Aeromagnetic anomaly W is a circular, positive anomaly lo cated in the northeast corner of the West of Blind Hills 7.5-minu quadrangle (Figures 4 and 15). The approximate amplitude of t aeromagnetic anomaly is 300 gammas over background. The anomaly is over desert alluvium.

Ground magnetic traverse V-13 was run to investigate the source of the aeromagnetic anomaly. The profile of traverse V-1 (Figure 14) shows a broad, smooth positive magnetic anomaly w a maximum amplitude of approximately 400 gammas over back ground, extending from approximately 1,400 to 4,200 feet from t origin of the survey. The profile most likely represents deeply-b ied igneous or metamorphic rocks containing a minor amount of magnetite.

INVESTIGATION OF AEROMAGNETIC ANOMALY

Aeromagnetic anomaly F is an elongated, positive conto closure over desert alluvium northwest of the Vulcan mine o the Fountain Peak and Kelso Dunes 7.5-minute quadrangle (Figure 4). The aeromagnetic anomaly has an amplitude of proximately 300 gammas over background (Figure 16).

Ground magnetic traverse V-14 was obtained to investi the concealed rocks causing the anomaly (Figure 16). The p file (Figure 14) is a very smooth, broad (perhaps as much as mile wide), positive anomaly of approximately 450 gammas background. These characteristics may best represent a lar

eeply-buried igneous or metamorphic body with a slight ncrease in magnetite concentration over the surrounding ocks.

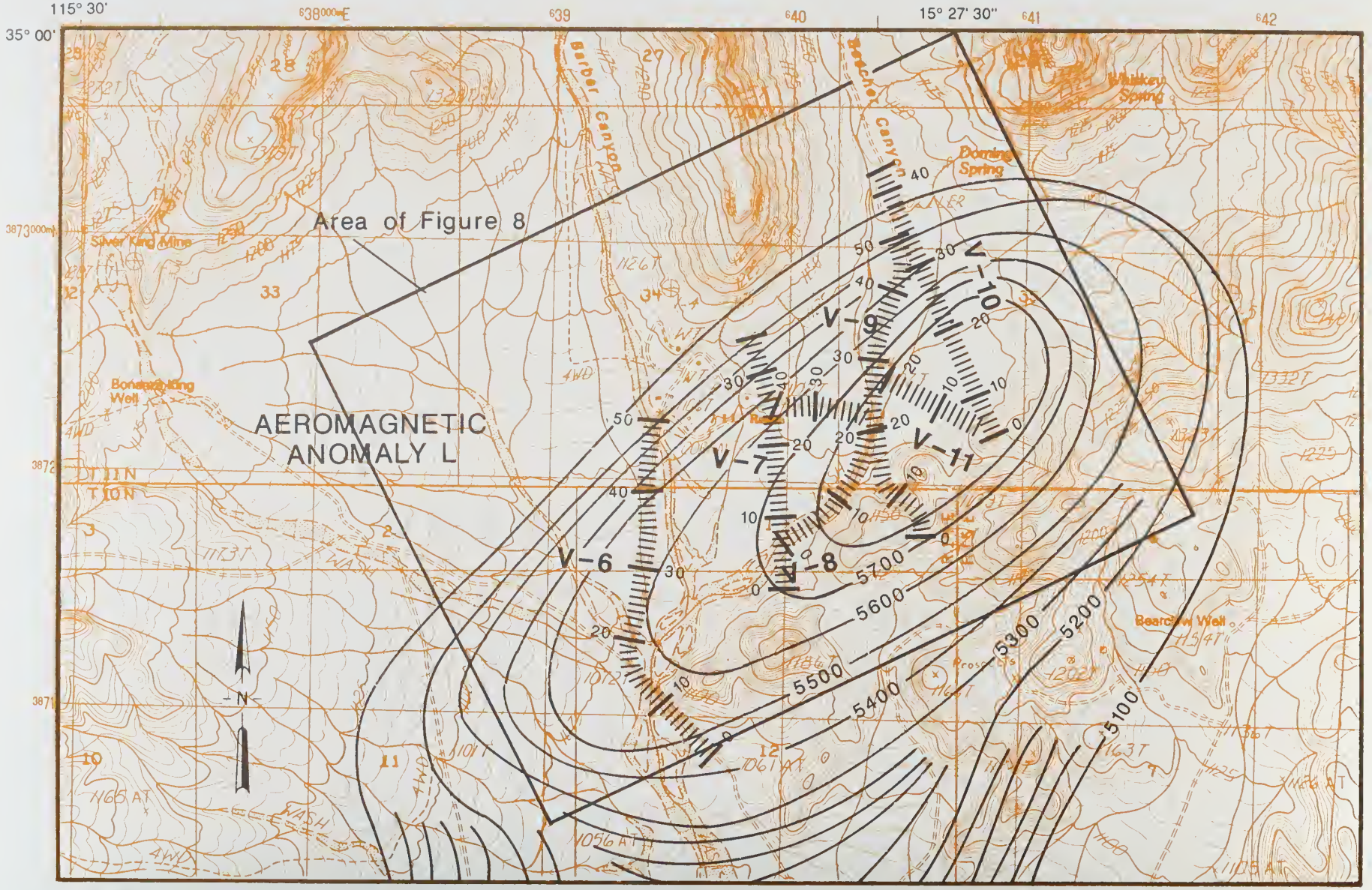
GROUND MAGNETIC INVESTIGATION OF THE EASTERN FRONT OF THE PROVIDENCE MOUNTAINS

As part of the geophysical investigations done for his report, two relatively-long ground magnetic raverses (V-15 and V-16) were run across the eastern ront of the Providence Mountains to determine whether agnetic methods would be useful for locating possible oncealed faults in this area (Figure 4).

Ground magnetic traverse V-15 was begun in Foshay ass and extended 16,200 feet eastward (Figure 17). The rofile of traverse V-15 on Figure 16 clearly shows that a ault or contact was encountered at station 114. A nange in soil color and as light topographic expression t this location supports this observation. The trend of he fault or contact is unknown. The approximately 500-amma, positive anomaly immediately east of the pos-ble fault suggests either that there is some magnetic mineralization at or adjacent to the fault zone or that the rocks to the east of the possible fault are much more magnetic than those to the west. Whether mineralization other than magnetite may be associated with this possible fault is unknown.

Ground magnetic traverse V-16 was begun near the Bighorn mine and extended for 13,000 feet southeastward from the mountains out over the desert alluvium (Figure 18). The locations of two faults exposed at the Bighorn mine are marked on the profile of traverse V-16 on Figure 19. The profile shows a positive magnetic anomaly of approximately 400 gammas over background, apparently associated with the faults. The relationship of faulting to other poorly-defined magnetic anomalies along the traverse is speculative. Outcrops southeast to Bighorn mine were not investigated during the geophysical survey. At station 80, there is a marked change in the character of the ground magnetic profile (Figure 19). The profile is much "smoother" to the southeast. Further investigations are needed in this area to determine if the change represents faulting.

Information gleaned from traverse V-15 and V-16 demonstrates the feasibility of employing ground magnetic techniques to delineate concealed faulting along the eastern front of the Providence Mountains. Mineralization of economic importance may be associated with such faults.



Base map from the U.S. Geological Survey

Figure 8. Map of Colton Hills area showing aeromagnetic anomaly L and ground magnetic survey lines V-6 through V-11. Scale 1:24,000.

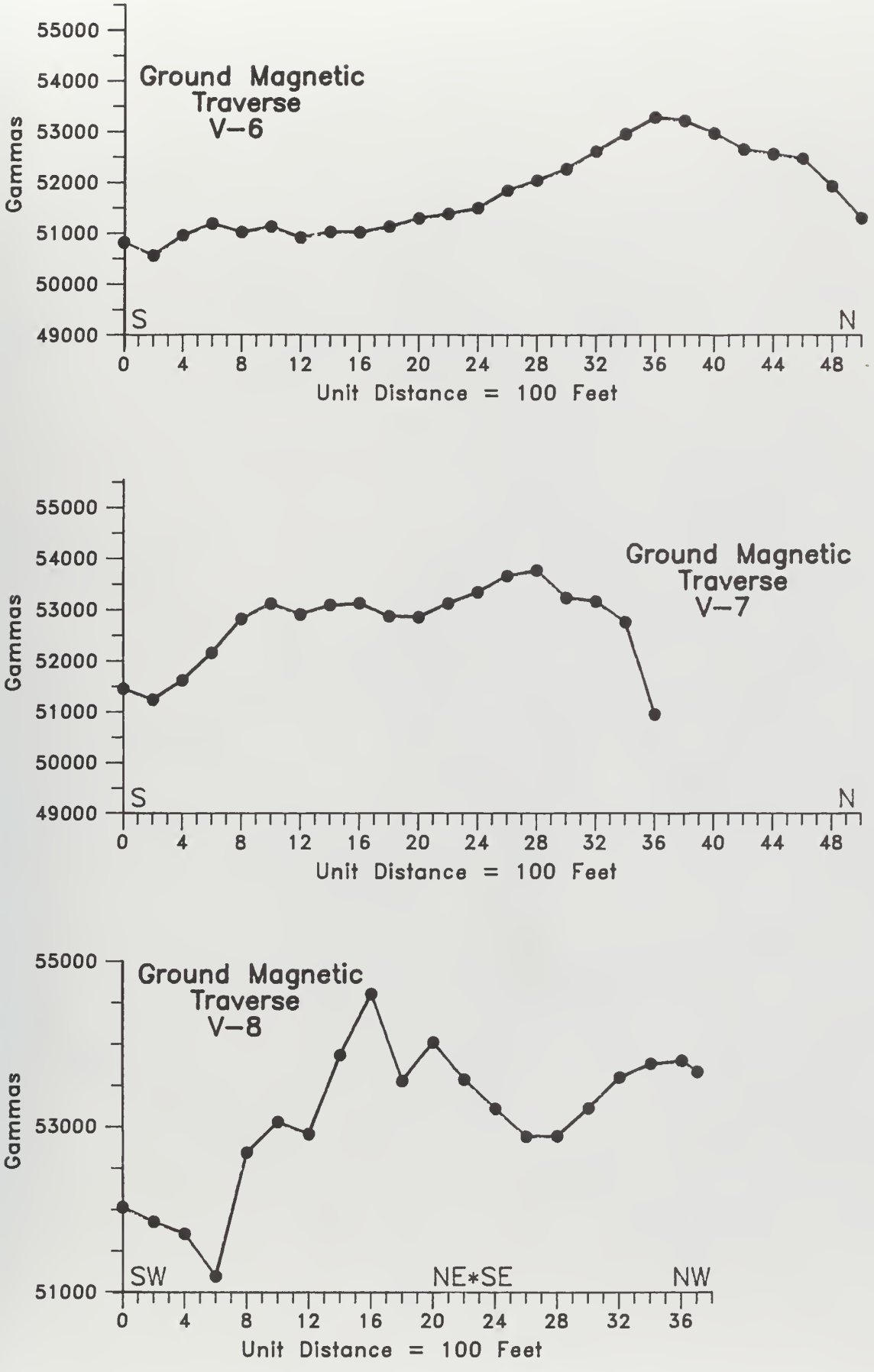


Figure 9. Ground magnetic traverses V-6 through V-8.

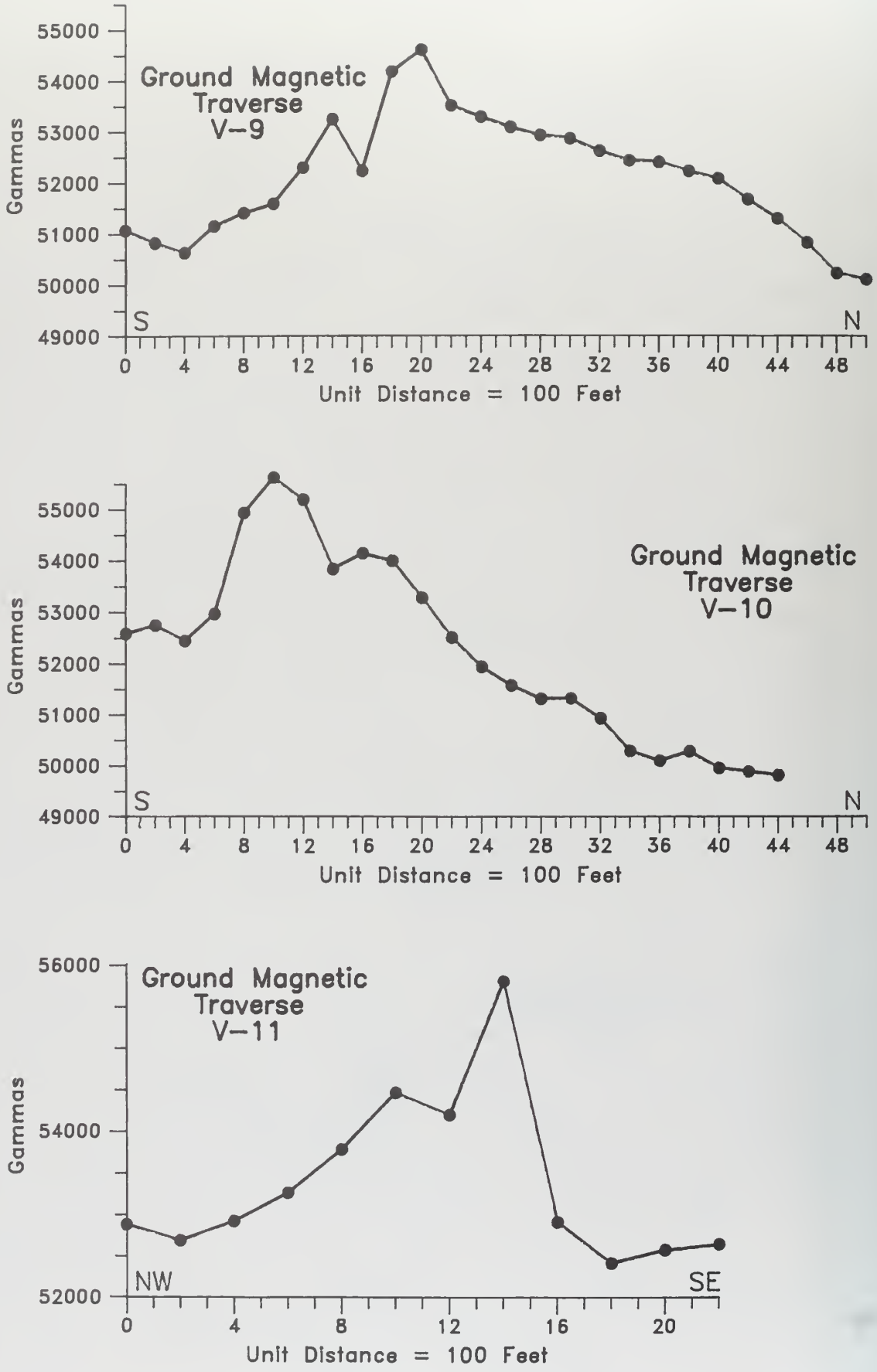


Figure 10. Ground magnetic traverses V-9 through V-11.

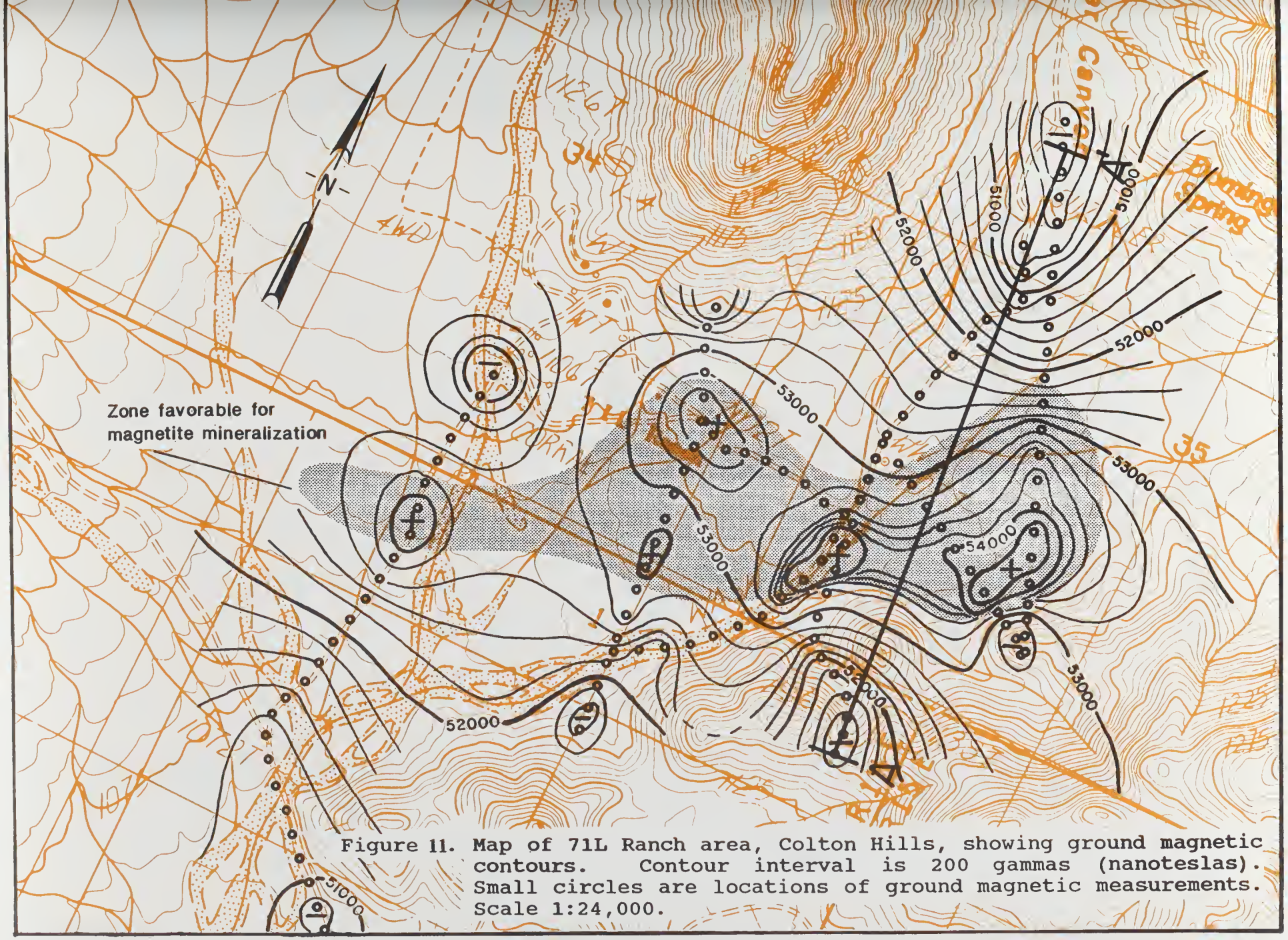


Figure 11. Map of 71L Ranch area, Colton Hills, showing ground magnetic contours. Contour interval is 200 gammas (nanoteslas). Small circles are locations of ground magnetic measurements. Scale 1:24,000.

Base map from the U.S. Geological Survey

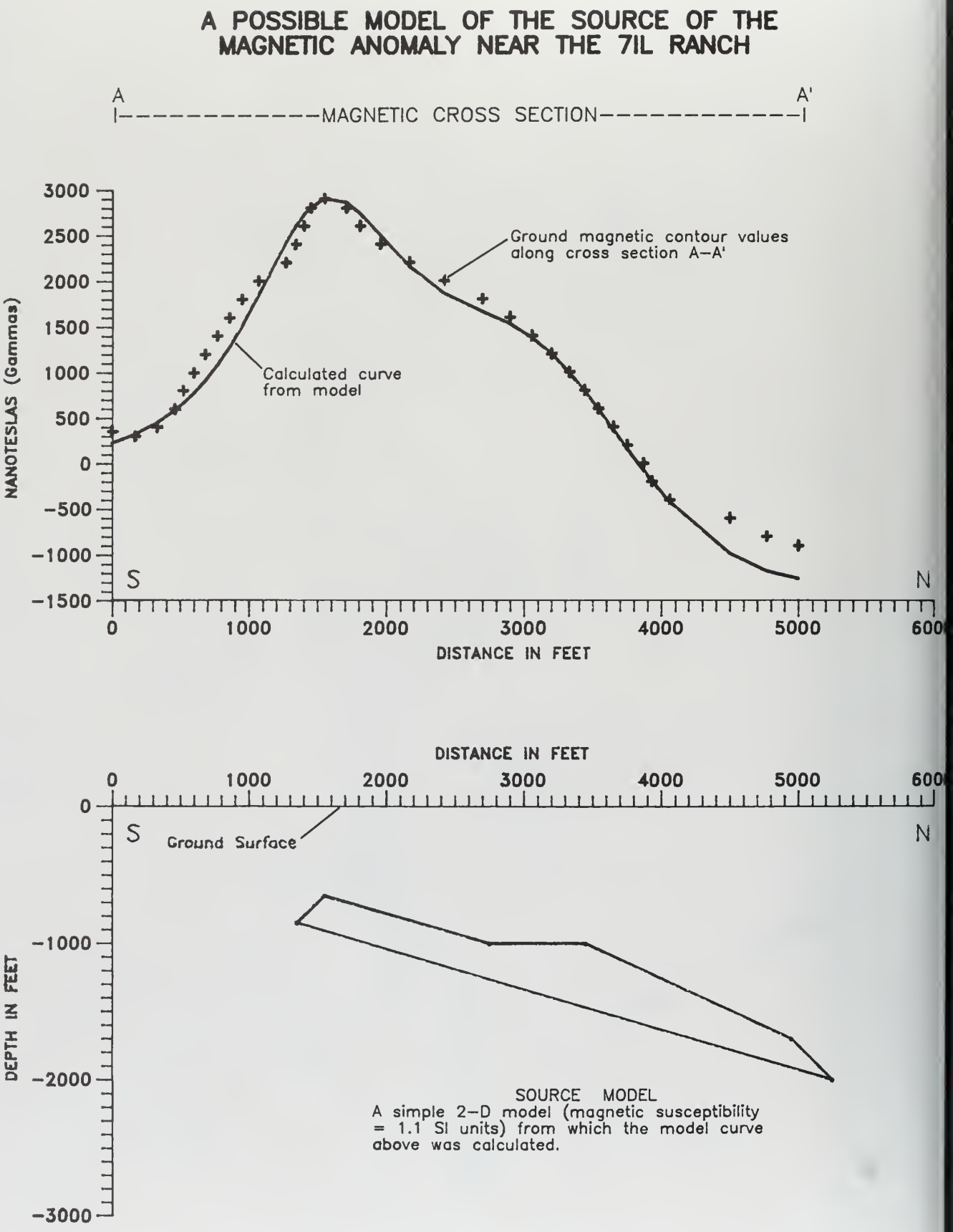


Figure 12. Computer model of possible source of magnetic anomaly L.

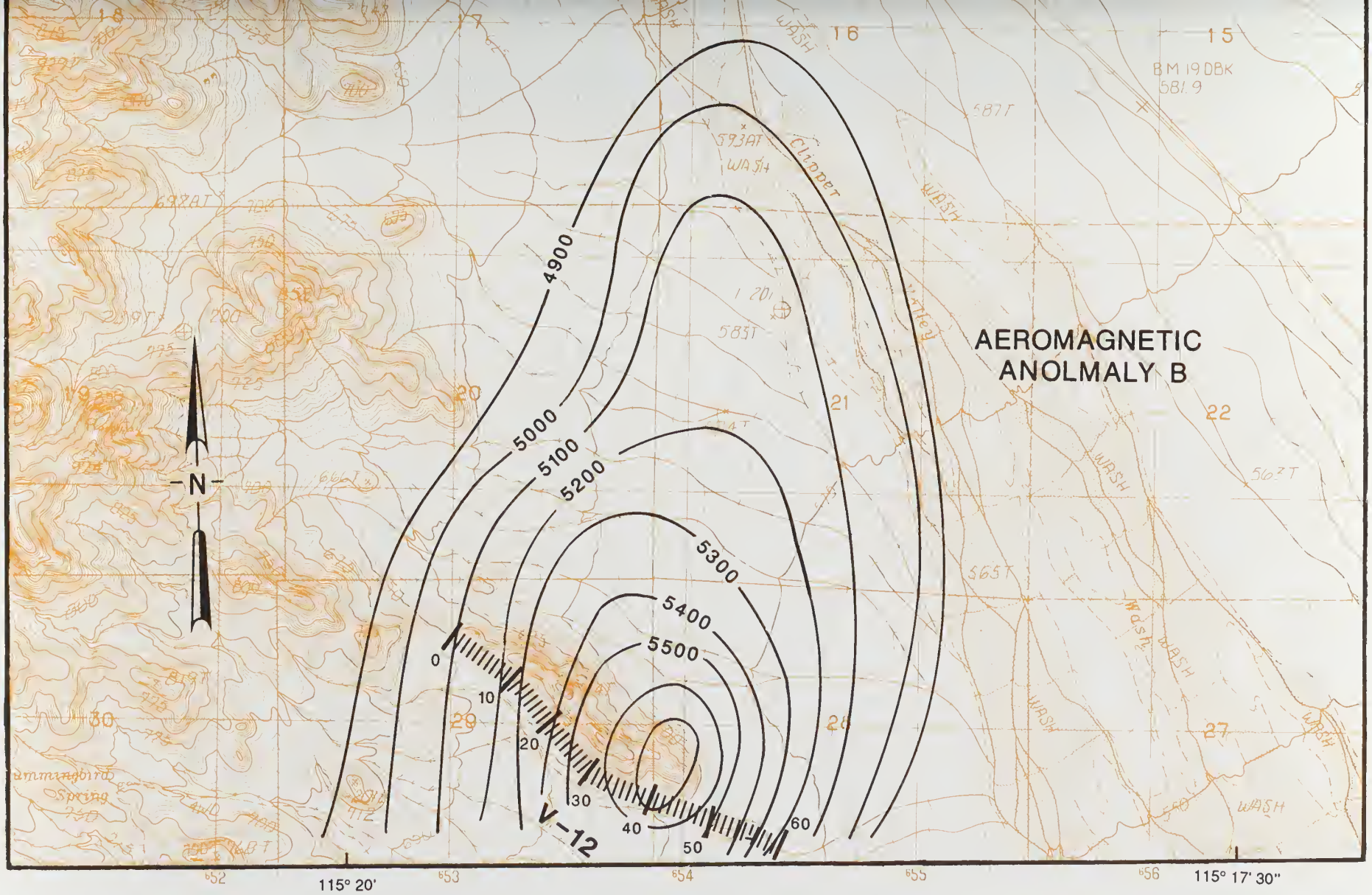


Figure 13. Map of the eastern Clipper Mountains area showing locations of aeromagnetic anomaly B and ground magnetic survey V-12. Scale 1:24,000.

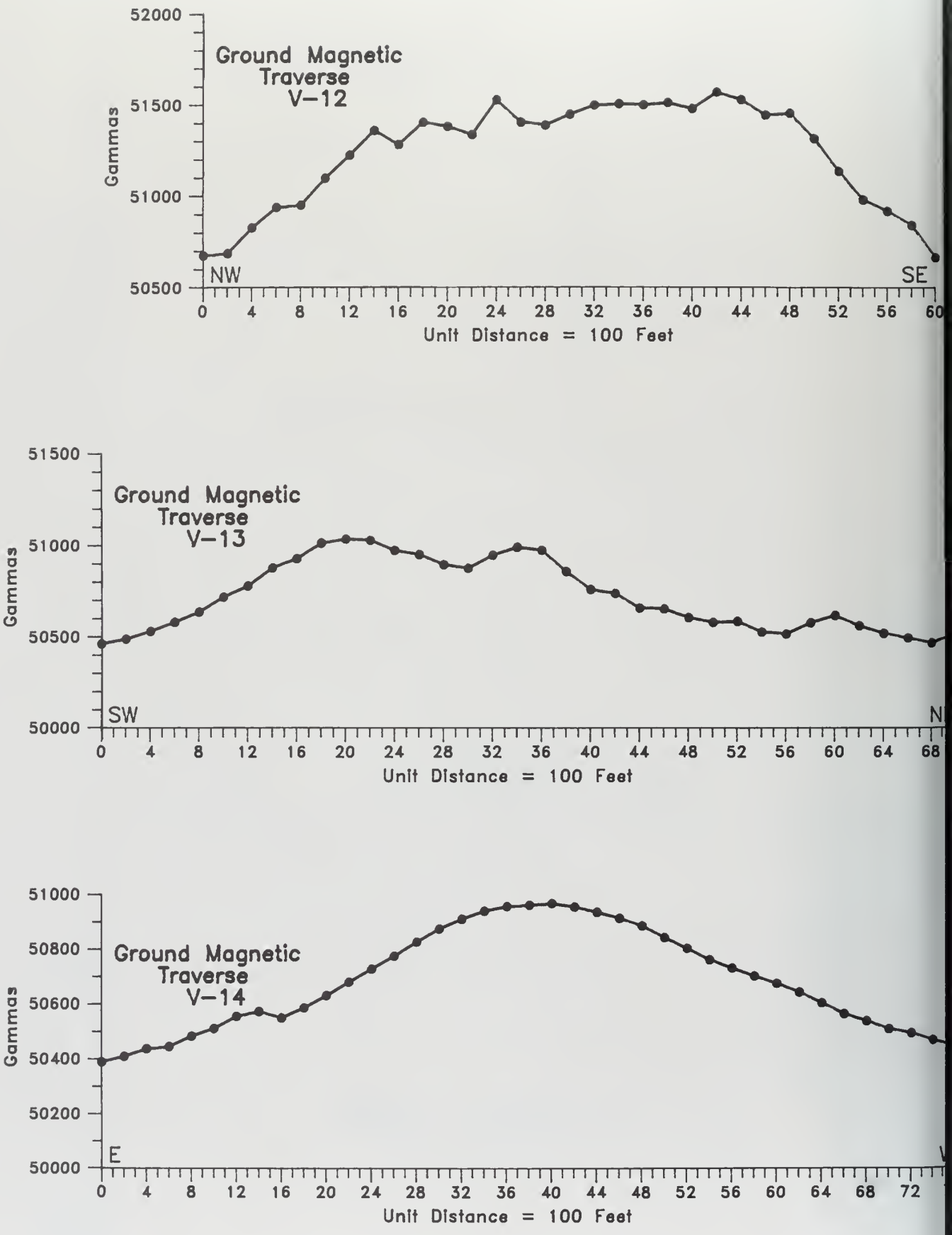


Figure 14. Ground magnetic traverses V-12 through V-14.

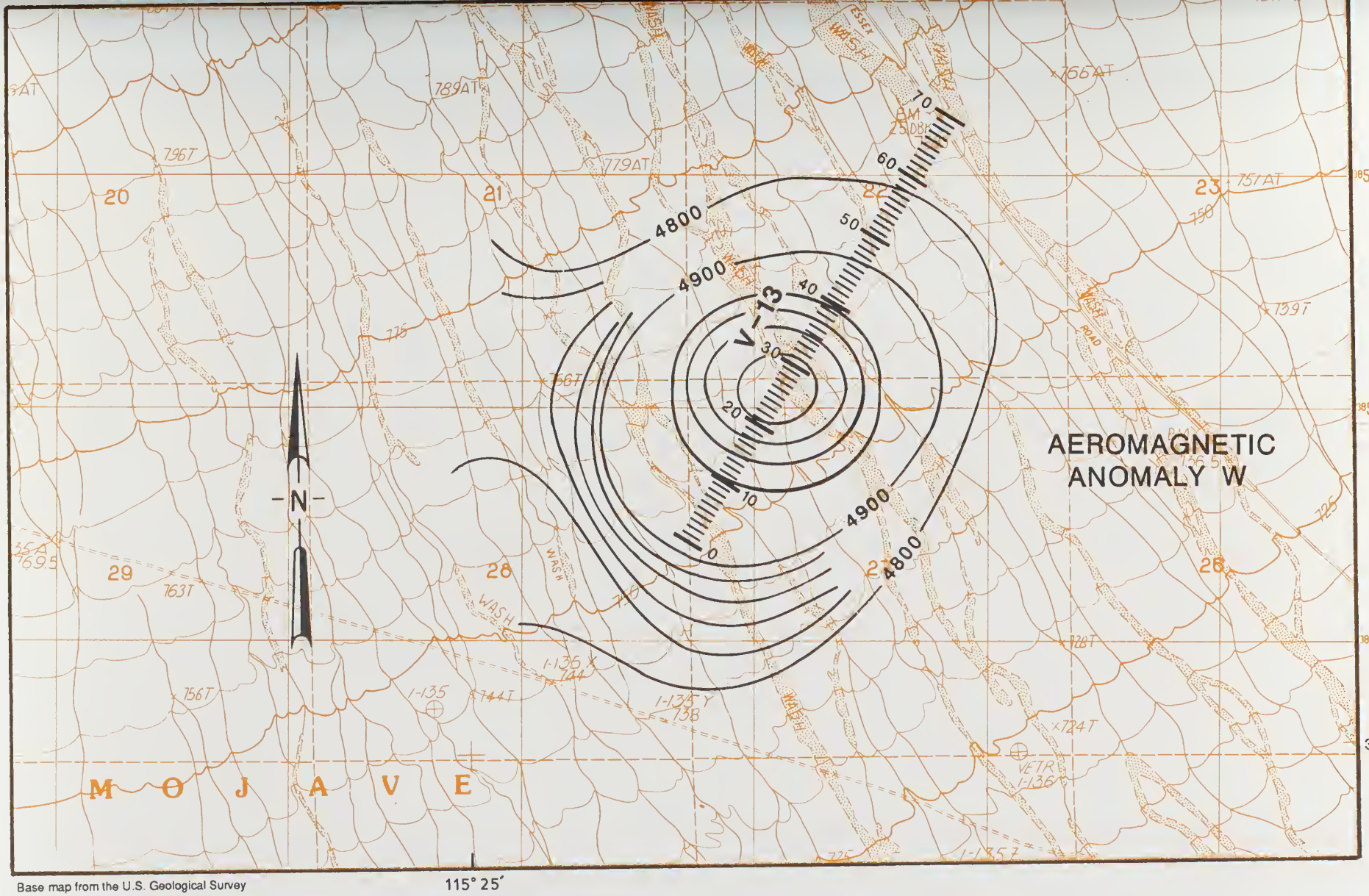


Figure 15. Map of Clipper Valley area (northeast part of the West of Blind Hills 7.5-minute quadrangle) showing locations of aeromagnetic anomaly W and ground magnetic survey V-13. Scale 1:24,000.

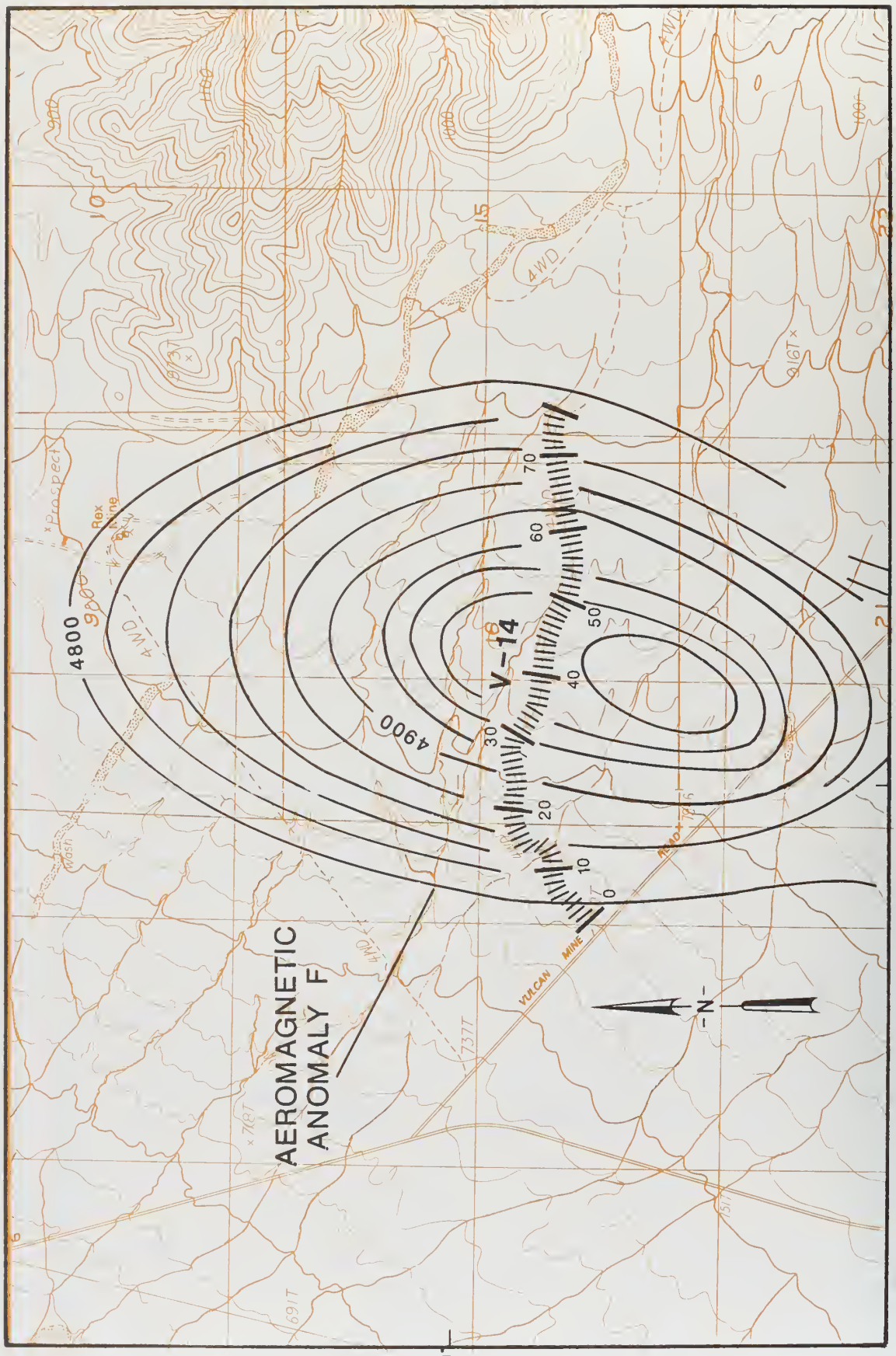


Figure 16. Map of the Vulcan Mine Road area showing aeromagnetic anomaly F and ground magnetic survey line V-14. Scale 1:24,000.

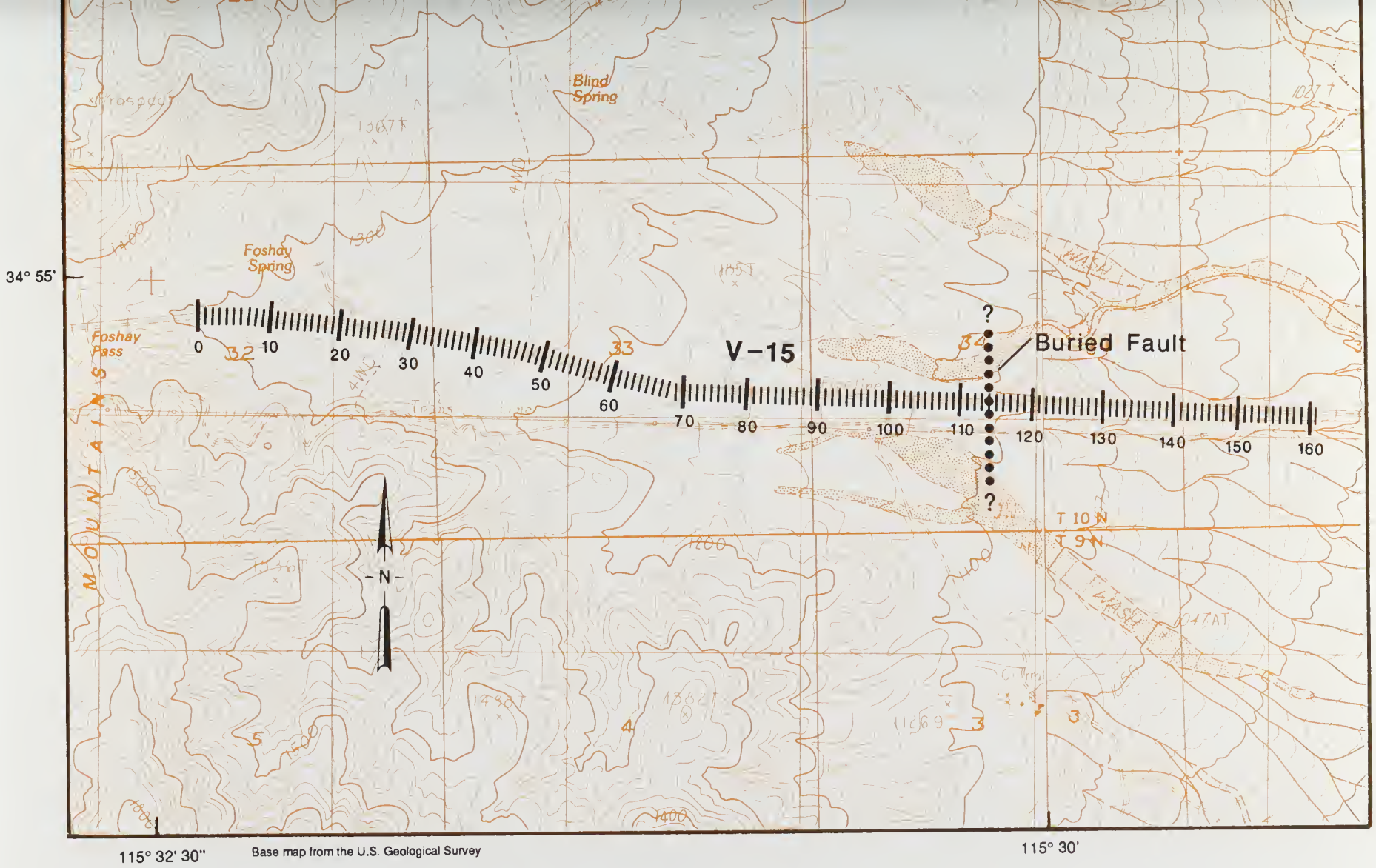
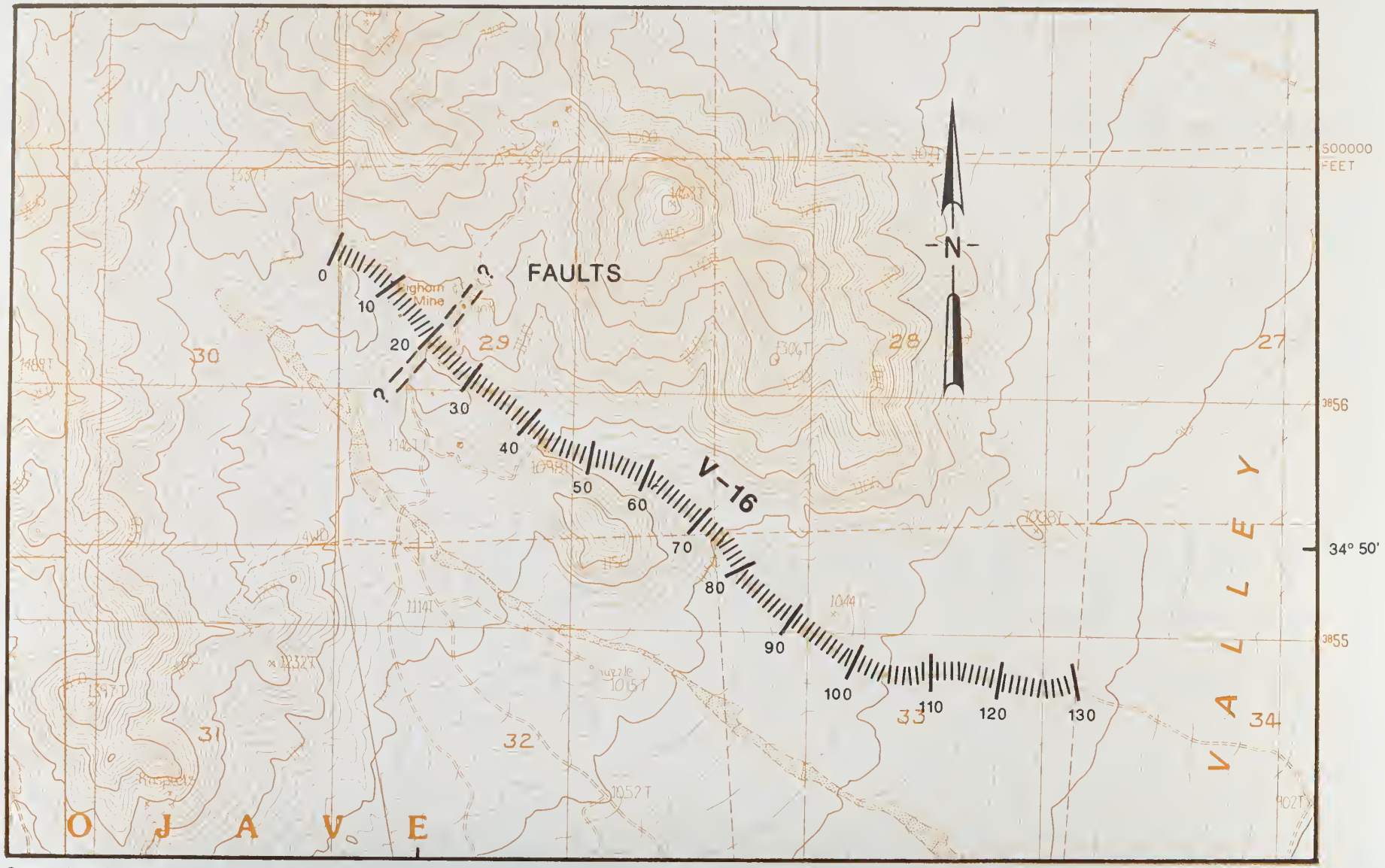


Figure 17. Map of Foshay Pass area showing location of ground magnetic survey line V-15. Scale 1:24,000.



Base map from the U.S. Geological Survey

Figure 18. Map of the Bighorn Mine area, southern Providence Mountains, showing location of ground magnetic traverse V-16. Scale 1:24,000.

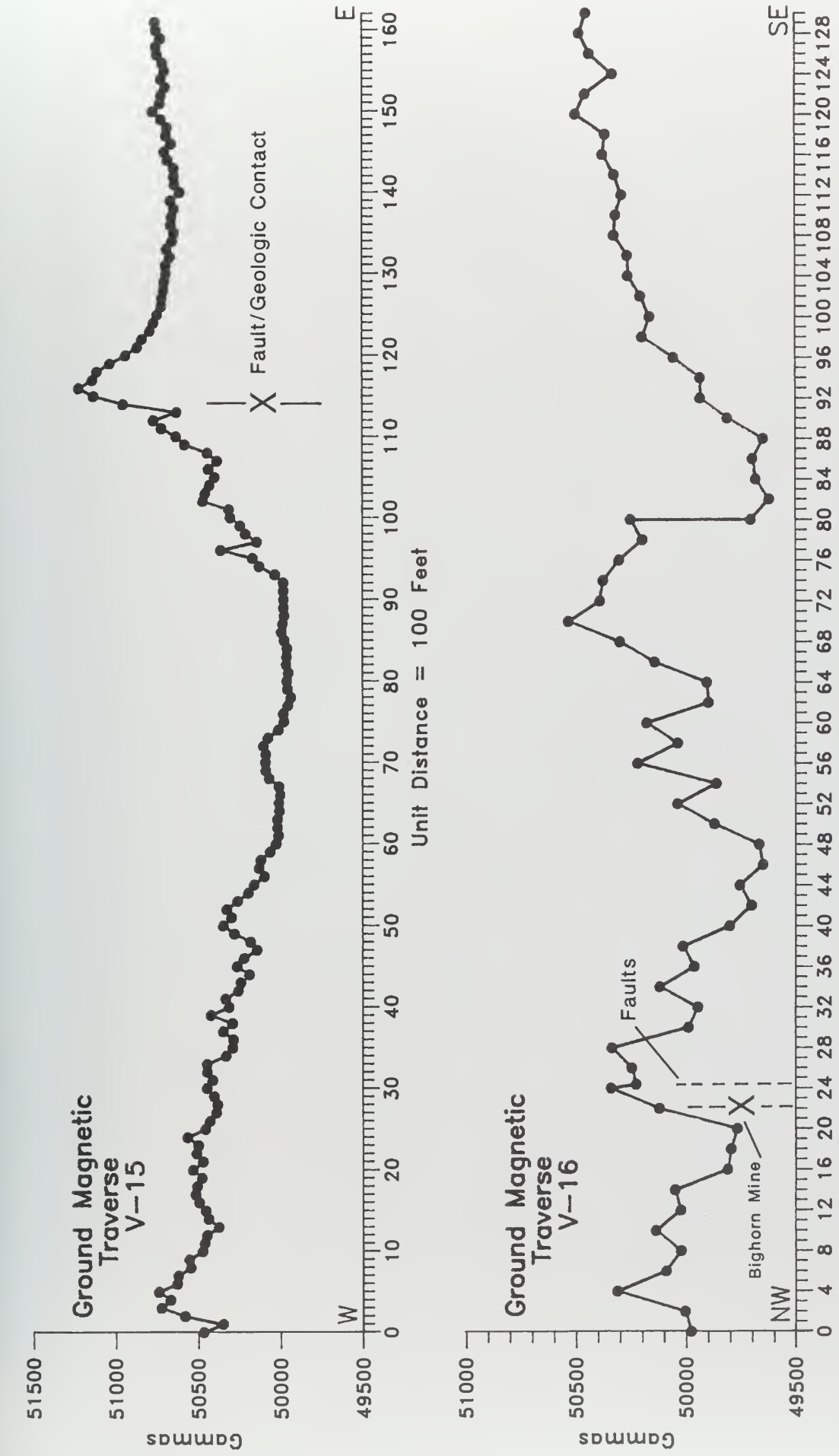


Figure 19. Ground magnetic traverses V-15 and V-16.

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FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES,
SAN BERNARDINO COUNTY, CALIFORNIA

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA-PETE WILSON, GOVERNOR
THE RESOURCES AGENCY-DOUGLAS P. WHEELER, SECRETARY FOR RESOURCES
DEPARTMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

Topographic base by U.S.Geological Survey mosaicked from Kerens, Flynn, and Colton Well 15-minute quadrangles

GEOLOGY OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES SAN BERNARDINO COUNTY, CALIFORNIA

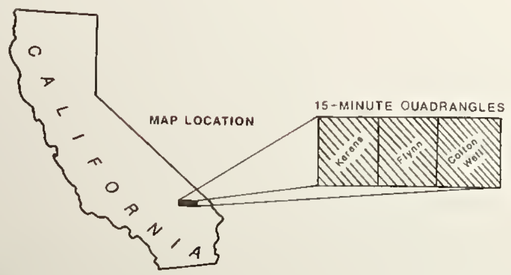
Compiled by
R.C. LOYD

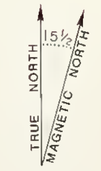
1987

SCALE 1:62,500

1 0 1 2 3 4 Miles
3000 0 3000 6000 9000 12000 15000 18000 21000 Feet
0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET





DECLINATION

METALLI

STATE OF CALIFORNIA-PETE WILSON, GOVERNOR
ES AGENCY-DOUGLAS P. WHEELER, SECRETARY FOR RESOURCES
TMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

SPECIAL REPORT 168
GEOLOGY OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES
PLATE 1

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RENS, FLYNN, AND COLTON WELL
UTE QUADRANGLES
DINO COUNTY, CALIFORNIA

Compiled by
R.C. LOYD

1987

SCALE 1:62,500

0 1 2 3 4 Miles
0 3000 6000 9000 12000 15000 18000 21000 Feet
0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET

MAP EXPLANATION

Cenozoic

- Q — Quaternary alluvium--includes young and older alluvial and fluvial deposit of clay, silt, sand, and gravel.
- Qs — Dune sand.
- QTg — Sand, gravel, and conglomerate.
- Tfg — Fanglomerate deposits consisting of poorly sorted granitic and metamorphic rock clasts in a silty matrix.
- Tbr — Tectonic breccia composed of igneous bedrock.
- Tb — Basalt flows.
- Ttw — Welded rhyolite tuff--in the Bristol and Old Dad Mountains, this unit contains conspicuous chatoyant sanidine phenocrysts characteristic of the Peach Springs Tuff Formation.
- Tss — Tuffaceous sandstone.
- Tt — Pumaceous and lithic tuff with minor tuff breccia and tuffaceous sandstone--locally includes vitrophyric flows.
- Tva — Airfall and ash-flow tuff--white to buff, bedded ash-flow tuff, air fall tuff, and tuff breccia.
- Trf — Flow-banded rhyodacite--gray siliceous prominently banded rhyodacite or rhyolite flows containing rare plagioclase and biotite phenocrysts.
- Trd — Rhyodacite flows and tuff.
- Tid — Hornblende dacite.
- Tri — Rhyolite dikes.
- Ttb — Andesite tuff breccia, flow breccia, lahar and flows.
- Tba — Basaltic andesite flows, flow breccia, cinder breccia, lahar, tuff breccia, and minor intrusive rock.
- Tvu — Undifferentiated volcanic rocks including tuff, tuff breccia, pumice, flow, flow breccia, and volcanic derived sediments.
- TJfp — Fountain Peak Rhyolite--siliceous, generally aphyric, biotite rhyolite. May represent intrusion, dome, and flows of Tertiary and/or Jurassic age.

Mesozoic

- Kgr — Medium- to coarse grained, granite, monzogranite, and granodiorite.
- Jv — Hypabyssal and metavolcanic rocks--dark--weathering highly propylitically altered medium- to fine-grained, quartz-poor hypabyssal rocks and dark-colored foliated, fine-grained, intermediate to silicic metavolcanic rocks.
- Jva — Albitized metavolcanic rocks--white albitized fine- to medium-grained metarhyolite. May include thin beds of meta-arkose.
- Jsd — Sheeted dikes--dikes consisting of dark dacite porphyry, flinty light-green aphanitic rock, and light-bluish-gray fine-grained quartzofeldspathic rock.
- Jqm — Medium- to coarse grained, subequigranular, melanocratic, granitoid rock predominantly of quartz monzonite to quartz syenite composition.
- Jmd — Dark gray to black, medium- to coarse-grained, granitoid rock predominantly of monzodiorite to diorite composition.
- Jgf — Felsic granitoids--white, porphyritic, coarse-grained biotite monzogranite; light-gray, medium-grained, leucocratic granite; and yellow to pink, coarse-grained, quartz-rich biotite monzogranite.
- Jgm — Mafic granitoids--mesocratic to melanocratic granitoid rocks ranging from monzogranite to gabbro. Common rock types are biotite monzogranite and biotite-hornblende monzogranite and quartz monzonite; less common are biotite-hornblende diorite, olivine-augite gabbro, and biotite monzonite.
- Jgr — Granitoid rocks, chiefly quartz monzonite, biotite granite, and syenite. Locally highly altered and/or weathered.
- JRc — Clastic and carbonate rocks--shale, sandstone, conglomerate, impure limestone, and tuff; lower part considered to be the Moenkopi Formation by Hazzard (1954).
- JpCgn — Mixed gneiss (Jurassic and Proterozoic?)--granitic gneiss and mafic gneiss pervasively intruded parallel to foliation by Jurassic granitoids.
- Tqd — Quartz diorite to quartz monzonite gneiss.
- MpCgn — Diorite gneiss of Mesozoic or Proterozoic age.

Paleozoic

- Sk — Skarn.
- Pzm — Metasedimentary rocks--tan to light-gray marble and calc-silicate rocks. Contact metamorphosed adjacent to Jurassic plutonic rocks. Locally could include Triassic metasedimentary strata.
- PCDl — Limestone (Permian, Carboniferous, and Devonian)--sandy and clean limestone of the Bird Spring Formation, locally cherty massive limestone of the Mone Cristo Limestone, and limestone and dolomite of the Sultan Limestone.
- Cd — Dolomite--buff and gray dolomite; corresponds to the Cambrian Nopah and Bonanza King Formations.
- Cc — Clastic rocks (Cambrian)--quartzite, shale, shaley limestone, and limestone. Corresponds to Cadiz Formation, Chambless Limestone, and Latham Shale of Hazzard (1954), and underlying Prospect Mountain Quartzite.

Precambrian

- pCgn — Gneiss (Proterozoic)--biotite monzogranite gneiss, with minor amphibole-rich gneiss, biotite schist, and pegmatite.
- pCgns — Gneiss and schist of variable composition.

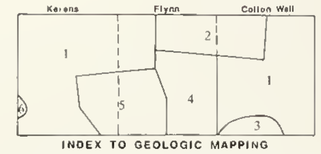
MINE/PROSPECT SYMBOLS

METALLIC		NON METALLIC	
○	Lode Gold	B	Barite
●	Placer Gold	F	Fluorite
◑	Copper	P	Perlite
◆	Silver-Lead-Zinc	M	Marble
■	Tungsten		
✱	Iron		

X — Small Prospect
○³ — Mine Index Number
— Trend of Deposit

MAP SYMBOLS

- CONTACT--Dashed where approximately located.
- FAULT--Dashed where approximately located; dotted where concealed.
- LOW-ANGLE NORMAL FAULT--Dashed where approximately located; dotted where concealed; queried where uncertain. Hachures on upper plate.
- SHEAR ZONE
- 15 — Strike and Dip of sedimentary beds.
- 30 — Strike and Dip of foliation.
- Fracture zone



INDEX TO GEOLOGIC MAPPING

1. Southern Pacific Company, 1959, Geology and mineral resources survey, Township 8 North, Ranges 9-10, 11-12, 13-14, 15-16 East; Township 9 North, Ranges 9-10, 11-12, 13-14, 15-16 East; Township 10 North, Ranges 9-10, 11-12, 13-14, 15-16 East; Township 11 North, Ranges 9-10, 11-12, 13-14, 15-16 East; San Bernardino Base and Meridian, San Bernardino County, California: scale 1:24,000.

2. Miller, O.M., Fox, L.K., Glick, L.L., and Stone, Paul, unpublished U.S. Geological Survey Map: scale 1:62,500.

3. Lyki, Michael Edgas, 1982, The geology and geochemistry of the Tertiary volcanic rocks of the northeastern half of the Clipper Mountains, Eastern Mojave Desert, California: unpublished University of California Riverside M.S. Thesis; 120 p., scale 1:24,000.

4. Miller, D.M., Glick, L.L., Goldfarb, Richard, Simpson, R.W., Hoover, D. M., Detra, David, Dohrenwend, J.C., and Munts, S.R., 1985, Mineral resources and resource potential map of the South Providence Mountains Wilderness Study Area, San Bernardino County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1780-A, 29 p., scale 1:62,500.

5. Howard, Keith A., Kilburn, James E., Simpson, Robert W., Fitzgibbon, Todd, T., Detra, David E., Raines, Gary L., and Sabine, Charles, in publication, Mineral resources of part of the Briston/Granite Mountains Wilderness Study Area, San Bernardino County, California: U.S. Geological Survey Bulletin 1712-C, scale 1:62,500.

6. Casey, Brian Joseph, 1981, Geology of a portion of the northwestern Briston Mountains, Mojave Desert, California: unpublished University of California Riverside M.S. Thesis; 128 p., scale 1:24,000.

DIVISION OF MINES AND GEOLOGY
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CDCA 250
CDCA 256
CDCA 262
CDCA 263
(h) MRZ-4
(h-1) MRZ-3a
(h-1) MRZ-2b
(h-4) MRZ-3a

Topographic base by U.S.Geological Survey mosaicked from Kerens, Flynn, and Colton Well 15-minute quadrangles

MINERAL LAND CLASSIFICATION MAP OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES SAN BERNARDINO COUNTY, CALIFORNIA

by
R.C. LOYD

SCALE 1:62,500
1 0 1 2 3 4 Miles
3000 0 3000 6000 9000 12000 15000 18000 21000 Feet
1 0 1 2 3 4 5 Kilometers
CONTOUR INTERVAL 40 FEET

Mineral Deposits formed by Hydrothermal Processes

(base and precious metals)

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

1. Hercules
2. Kit Fox
3. Ribbon Rock
4. Prospect
5. Parker
6. Buena Suerte
7. Commanche
8. Prospect
9. Golden Legend
10. Iron Victory
11. Silver Lode
12. Prospect
13. Lopez No. 3
14. Iris Fin
15. Black Jack
16. Prospect
17. Kelso North
18. Rox
19. Lone Tree
20. Cornfield Spring Con.
21. Kelso South
22. Bonanza 1-8
23. Iron Mtn.
24. Prospect
25. Rector Not
26. Vulcan
27. Burro
28. Copper King
29. Tip Top
30. Burro No. 31
31. East Burro
32. Burro 54 and 55
33. Sunrise
34. Prospect
35. Silver King
36. Silver Queen

MINERAL RESOURCE ZONE CATEGORIES

Mineral Resource Zone (MRZ) categories set forth in the guidelines established by the State Mining and Geology Board have been adapted to the California Mineral Land Classification Diagram (Figure 3). These adaptations are presented below:

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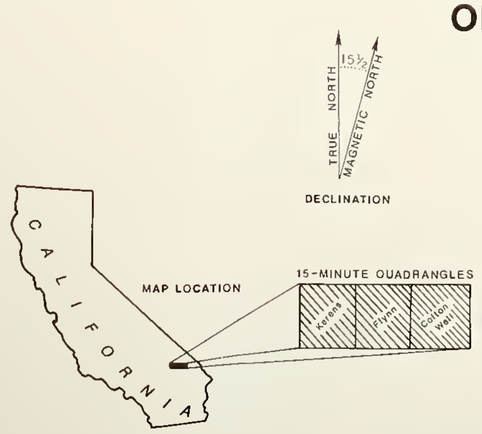

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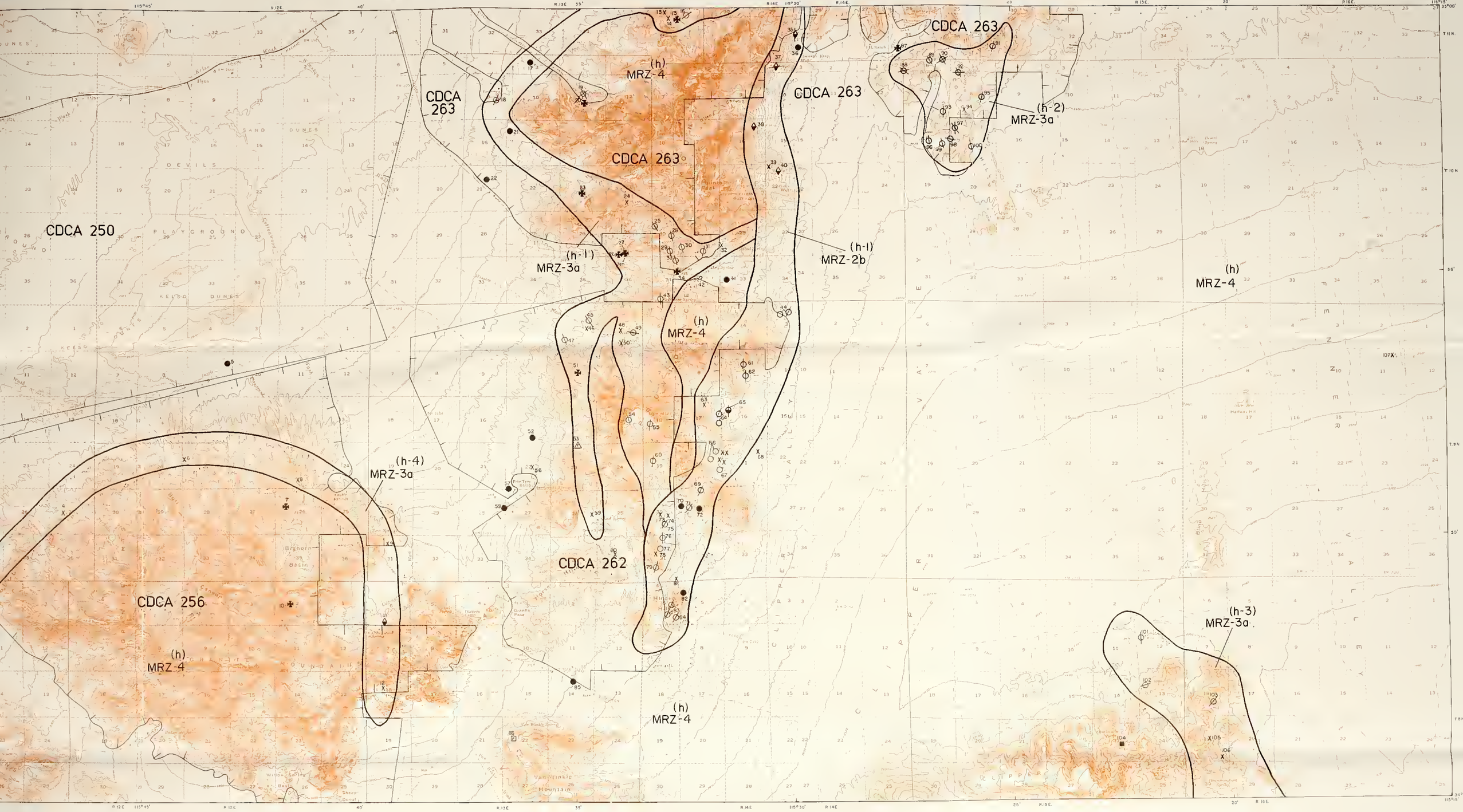
DEPARTMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

TN24
C3
R33
no. 168
Plate 2
Phys
Sci Lib


CDCA 250
CDCA 263
CDCA 263
CDCA 263
CDCA 262
CDCA 256
(h)
MRZ-4
(h-1)
MRZ-3a
(h-1)
MRZ-2b
(h-2)
MRZ-3a
(h)
MRZ-4
(h)
MRZ-4
(h-4)
MRZ-3a
(h)
MRZ-4
(h)
MRZ-4
(h-3)
MRZ-3a
CDCA 263
DEVILS PLAYGROUND
KELSO DUNES
SAND DUNES
GRANITE MOUNTAINS
Bighorn Basin
Van Winkle Mountain
Hayfork Hill
Wilson Spring
Sheep Canyon
Granite Pass
Hi Mesa
Hi Mesa
Hi Mesa

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

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DEPARTMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

CDCA 250

(s)
MRZ-4

CDCA 263

(s-1)
MRZ-3a

(s-2)
MRZ-2b

(s-3)
MRZ-2b

(s-1)
MRZ-2b

CDCA 262

CDCA 256

(s-3)
MRZ-3a

(s-4)
MRZ-2b

Topographic base by U.S.Geological Survey mosaicked from Kerens, Flynn, and Colton Well 15-minute quadrangles

MINERAL RESOURCE ZONE CATEGORIES

Mineral Resource Zone (MRZ) categories set forth in the guidelines established by the State Mining and Geology Board have been adapted to the California Mineral Land Classification Diagram (Figure 3). These adaptations are presented below:

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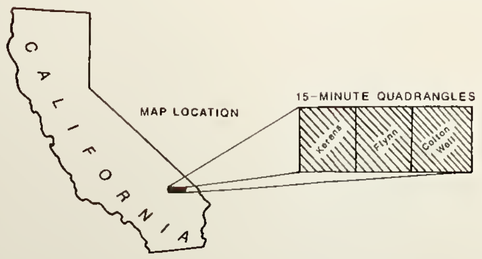

MINERAL LAND CLASSIFICATION MAP OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES SAN BERNARDINO COUNTY, CALIFORNIA

by

R.C. LOYD

SCALE 1:62,500

1 0 1 2 3 4 Miles

3000 0 3000 6000 9000 12000 15000 18000 21000 Feet

1 0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET

Mineral Deposits formed by Contact Metasomatism

(iron and tungsten)

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

1. Hercules
2. Kit Fox
3. Ribbon Rock
4. Prospect
5. Parker
6. Buena Suerte
7. Comanche
8. Prospect
9. Golden Legend
10. Iron Victory
11. Silver Lode
12. Prospect
13. Lopez No. 3
14. Iris Fin
15. Black Jack
16. Prospect
17. Kelso North
18. Rex
19. Lone Tree
20. Cornfield Spri
21. Kelso South
22. Bonanza 1-8
23. Iron Mtn.
24. Prospect
25. Rector Hot
26. Vulcan
27. Burro
28. Copper King
29. Tip Top
30. Burro No. 31
31. East Burro
32. Burro 54 and 5
33. Sunrise
34. Prospect
35. Silver King
36. Silver Queen

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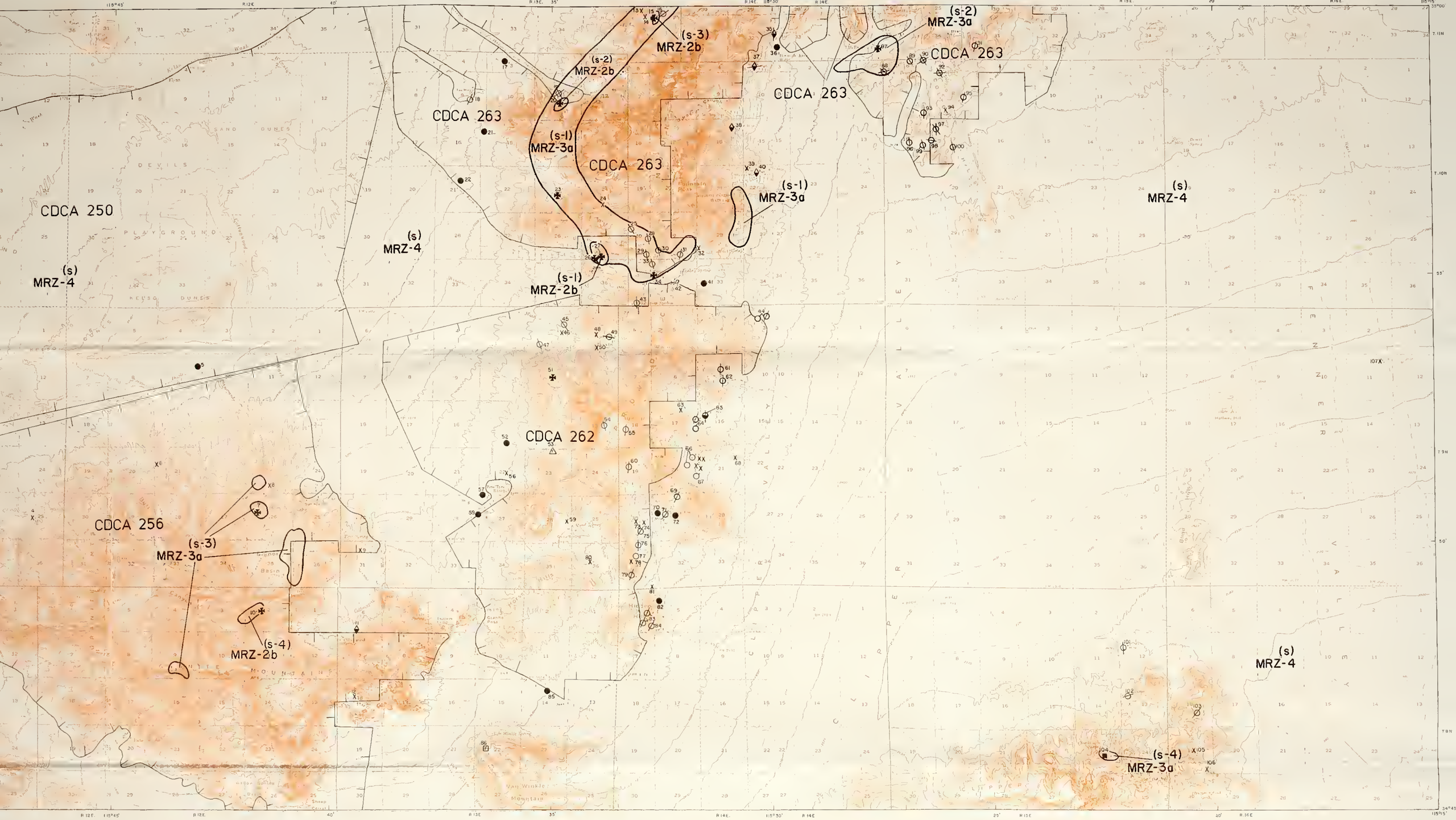
C3
A33
no. 168
Plate 3
Phys
Sci Lib



MINERAL LAND CLASSIFICATION MAP OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES SAN BERNARDINO COUNTY, CALIFORNIA

by

R.C. LOYD

SCALE 1:62,500

1 0 1 2 3 4 Miles

3000 0 3000 6000 9000 12000 15000 18000 21000 Feet

1 0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET

TRUE NORTH
15½°
MAGNETIC NORTH

DECLINATION

Mineral Deposits formed by Contact Metasomatism

(iron and tungsten)

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

MINE/PROSPECT LIST

1. Hercules
2. Kit Fox
3. Ribbon Rock
4. Prospect
5. Parker
6. Buena Suerte
7. Commenche
8. Prospect
9. Golden Legend
10. Iron Victory
11. Silver Lode
12. Prospect
13. Lopez No. 3
14. Isle Fin
15. Black Jack
16. Prospect
17. Kelso North
18. Rex
19. Lone Tree
20. Cornfield Spring Con.
21. Kelso South
22. Bonanza 1-8
23. Iron Mtn.
24. Prospect
25. Rector Hot
26. Vulcan
27. Burro
28. Copper King
29. Tip Top
30. Burro No. 33
31. East Burro
32. Burro 54 and 55
33. Sunrise
34. Prospect
35. Silver King
36. Silver Queen
37. Bonanza King
38. C & K
39. Prospect
40. Mitchell/Mexican
41. Duo Group
42. Foshay Pass Barite
43. Goldstone Group
44. Adams-Anna
45. Duo Donubo
46. Pennsylvania
47. Prospect
48. Centor
49. Crystal
50. Texas
51. Iron King
52. Green Beauty
53. Philadelphia
54. Lauri
55. Heymen
56. Sunview
57. Virginia Group
58. Edith Group
59. Midnight Group
60. Echo
61. Semplo
62. Prospect
63. Warm Springs
64. Pilot
65. Providence
66. Midee Touch
67. Prospect
68. Prospect
69. Buena Vista
70. Valeria Group
71. Big Horn
72. Prospect
73. Santa Anna
74. Wild Ass
75. Lady Luck
76. Prospect
77. Golden Gift
78. Prospect
79. Wild Cat
80. Golden Cross
81. Long Chance
82. Copper Cherlin
83. Golden Nugget
84. Hidden Hills
85. Lucky 7 Bird
86. Harper Perlite
87. B.C.
88. Adams-Ikes
89. Grando 1-7
90. Raindrop
91. Gold Star North 1-44
92. Max Dor 1 & 2
93. Prospect
94. Pink Falcon
95. Gold Star 1-10
96. Lou-Al-Mark
97. Prospect
98. Prospect
99. Silver Dutchess
100. Prospect
101. Gold Hammer
102. Prospect
103. Prospect
104. Clipper Mtns.
105. Prospect
106. Prospect
107. Prospect

MINE/PROSPECT SYMBOLS

METALLIC		NON METALLIC	
○	Lode Gold	B	Barite
●	Placer Gold	F	Fluorite
◑	Copper	P	Perlite
◆	Silver-Lead-Zinc	M	Marble
■	Tungsten		
✚	Iron		

X Small Prospect

○³ Mine Index Number

Trend of Deposit

(h-l) MRZ3a Mineral Resource Zone

U.S. Bureau of Land Management Wilderness Study Area (WSA) Boundaries (approximate)

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DEPARTMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

(i)
MRZ-4

CDCA 250

(i-1)
MRZ-2a

(i)
MRZ-4

CDCA 256

(i-4)
MRZ-3a
(perlite, zeolites)

(i-4)
MRZ-3a
(zeolites)

(i-4)
MRZ-3a
(perlite, zeolites)

(i-4)
MRZ-3a
(zeolites)

(i-3)
MRZ-3a
(quortzite)

(i-2)
MRZ-3a
(dolomite)

(i-1)
MRZ-3a
(limestone)

CDCA 263

(i-2)
MRZ-3a
(dolomite)

CDCA 263

(i-1)
MRZ-3a
(limestone)

CDCA 263

CDCA 262

(i-5)
MRZ-3a
(perlite)

Topographic base by U.S.Geological Survey
mosaicked from Kerens, Flynn, and Colton
Well 15-minute quadrangles

MINERAL LAND CLASSIFICATION MAP OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES SAN BERNARDINO COUNTY, CALIFORNIA

by
R.C. LOYD

SCALE 1:62,500

1 0 1 2 3 4 Miles

3000 0 3000 6000 9000 12000 15000 18000 21000 Feet

1 0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET

Industrial Minerals

(industrial sand, carbonate rock, quartzite, perlite, zeolite)

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

MAP LOCATION

CALIFORNIA

15-MINUTE QUADRANGLES

Kerens
Flynn
Colton Well

TRUE NORTH
15½°
MAGNETIC NORTH

DECLINATION

1. Hercules
2. Kit Fox
3. Ribbon Rock
4. Prospect
5. Parker
6. Buena Suerte
7. Comanche
8. Prospect
9. Golden Legend
10. Iron Victory
11. Silver Lode
12. Prospect
13. Lopez No. 3
14. Iris Fin
15. Black Jack
16. Prospect
17. Kelso North
18. Rex
19. Lone Tree
20. Cornfield Spring
21. Kelso South
22. Bonanza 1-8
23. Iron Mtn.
24. Prospect
25. Rector Mot
26. Vulcan
27. Burro
28. Copper King
29. Tip Top
30. Burro No. 31
31. East Burro
32. Burro 54 and 55
33. Sunrise
34. Prospect
35. Silver King
36. Silver Queen

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TN24
C3
A33
no. 168
Plate 4
Phys
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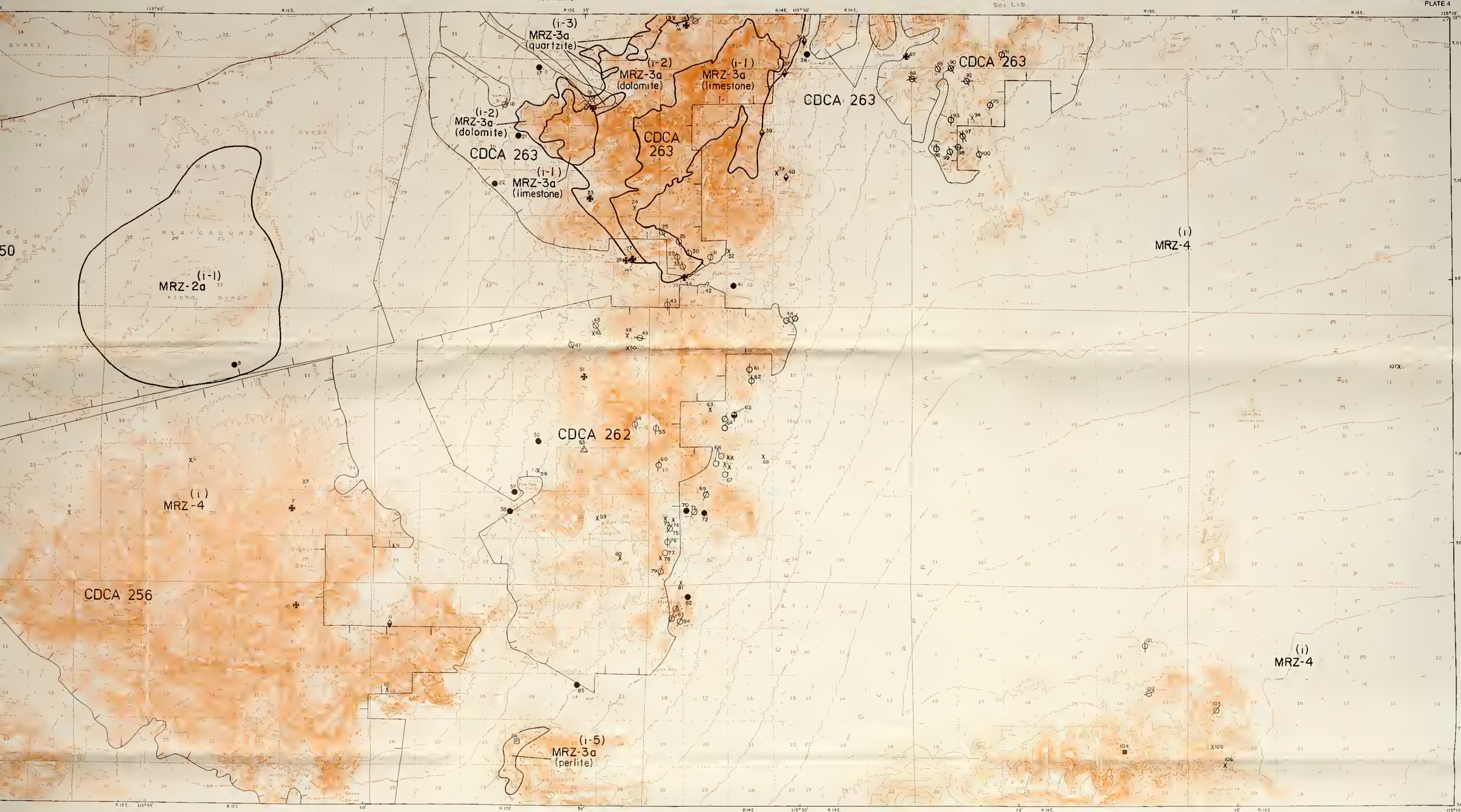
DEPARTMENT OF CONSERVATION·EDWARD G. HEIDIG, DIRECTOR

SPECIAL REPORT 168
MINERAL LAND C LASSIFICATION MAP OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES [INDUSTRIAL MINERALS]
PLATE 4



MINERAL LAND CLASSIFICATION MAP OF THE KERENS, FLYNN, AND COLTON WELL 15-MINUTE QUADRANGLES SAN BERNARDINO COUNTY, CALIFORNIA

by

R.C. LOYD

SCALE 1:62,500

1 0 1 2 3 4 Miles

3000 0 3000 6000 9000 12000 15000 18000 21000 Feet

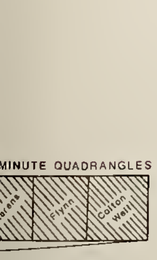
1 0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET

Industrial Minerals

(industrial sand, carbonate rock, quartzite, perlite, zeolite)

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761



MINUTE QUADRANGLES

DECLINATION

MINE/PROSPECT LIST

1. Norculas	37. Bonanza King	73. Santa Anna
2. Wit Fox	38. C & K	74. Wild Ass
3. Ribbon Rock	39. Prospect	75. Lady Luck
4. Prospect	40. Mitchell/Mexican	76. Prospect
5. Parker	41. Due Group	77. Golden Glit
6. Buena Suerte	42. Foshay Pass Barite	78. Prospect
7. Comanche	43. Goldstone Group	79. Wild Cat
8. Prospect	44. Adams-Anna	80. Golden Cross
9. Golden Legend	45. Blue Danube	81. Long Chance
10. Iron Victory	46. Pennsylvania	82. Copper Charlie
11. Silver Lodo	47. Prospect	83. Golden Nugget
12. Prospect	48. Center	84. Hidden Hills
13. Lopez No. 3	49. Cryatal	85. Lucky 8 Bird
14. Iris Fin	50. Texas	86. Harper Perlite
15. Black Jack	51. Iron King	87. B.C.
16. Prospect	52. Green Beauty	88. Adams-Ikes
17. Kelso North	53. Philadelphia	89. Grande 1-7
18. Rex	54. Lauri	90. Raindrop
19. Lone Tree	55. Heymen	91. Gold Star North 1-44
20. Cornfield Spring Con.	56. Sunview	92. Mae Dor 1 & 2
21. Kelso South	57. Virginia Group	93. Prospect
22. Bonanza 1-8	58. Edith Group	94. Pink Falcon
23. Iron Mtn.	59. Midnight Group	95. Gold Star 1-10
24. Prospect	60. Echo	96. Lou-Al-Mark
25. Rector Hot	61. Sample	97. Prospect
26. Vulcan	62. Prospect	98. Prospect
27. Burro	63. Warm Springs	99. Silver Dutchoss
28. Copper King	64. Pilot	100. Prospect
29. Tip Top	65. Providence	101. Gold Hammer
30. Burro No. 31	66. Midas Touch	102. Prospect
31. East Burro	67. Prospect	103. Prospect
32. Burro 54 and 55	68. Prospect	104. Clipper Mtns.
33. Sunrise	69. Buena Vista	105. Prospect
34. Prospect	70. Valcorio Group	106. Prospect
35. Silver King	71. Big Horo	107. Prospect
36. Silver Queen	72. Prospect	

MINE/PROSPECT SYMBOLS

METALLIC	NON METALLIC
○ Lode Gold	B Barite
● Placer Gold	F Fluorite
◑ Copper	P Perlite
◆ Silver-Lead-Zinc	M Marble
■ Tungsten	
✱ Iron	

X Smell Prospect

○³ Mine Index Number

Trend of Deposit

(h-l) MRZ-3a Mineral Resource Zone

U.S. Bureau of Land Menagement Wilderness Study Aree (WSA) Bounderies (approximete)

DIVISION OF MINES AND GEOLOGY
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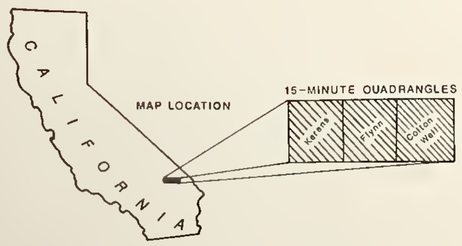
DEPARTMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

Topographic base by U.S.Geological Survey mosaicked from Kerens, Flynn, and Colton Well 15-minute quadrangles



DECLINATION

GEOCHEMICAL SURVEY SAMPLE LOCALITY MAP KERENS, FLYNN, AND COLTON WELL QUADRANGLES, SAN BERNARDINO, CALIFORNIA

by
R.C. LOYD

SCALE 1:62,500

1 0 1 2 3 4 Miles
3000 0 3000 6000 9000 12000 15000 18000 21000 Feet
1 0 1 2 3 4 5 Kilometers

CONTOUR INTERVAL 40 FEET

STATE OF CALIFORNIA-PETE WILSON, GOVERNOR
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DEPARTMENT OF CONSERVATION-EDWARD G. HEIDIG, DIRECTOR

A33
no. 168
Plate 5
Phys
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SPECIAL REPORT 168
GEOCHEMICAL SURVEY SAMPLE LOCALITY MAP
KERENS, FLYNN, AND COLTON WELL QUADRANGLES
PLATE 5

GEOCHEMICAL SURVEY SAMPLE LOCALITY MAP KERENS, FLYNN, AND COLTON WELL QUADRANGLES, SAN BERNARDINO, CALIFORNIA

by
R.C. LOYD

SCALE 1:62,500
1 0 1 2 3 4 Miles
3000 0 3000 6000 9000 12000 15000 18000 21000 Feet
1 0 1 2 3 4 5 Kilometers
CONTOUR INTERVAL 40 FEET

TRUE NORTH
15½°
MAGNETIC NORTH
DECLINATION

EXPLANATION

$\Delta^{s,p}$ −80 mesh stream sediment sample (s) heavy mineral (panned) sample (p).

$\blacktriangle^{M\text{-}I}$ mine and prospect chip and grab samples.

Note: Analytical results presented in Appendix C of text.